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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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[OFFICIAL NOTICE.]

December Meeting, Guild of Gas Managers.

OFFICE OF THE SECRETARY, December 2, 1895.

The December meeting of the Guild of Gas Managers will be held at Young's Hotel, Boston, Mass., at noon, of Saturday, the 14th inst.

A. K. QUINN, Secretary.

[OFFICIAL NOTICE.]

Annual Meeting, Society of Gas Lighting.

OFFICE OF THE SECRETARY, December 5, 1895.

The annual meeting of the Society of Gas Lighting will be held in the Arena, No. 39 West 31st street, New York, at 3 P.M. of Thursday, the 12th inst.

FRED. S. BENSON, Secretary.

BRIEFLY TOLD.

DEATH OF MR. JOSEPH G. EASTLAND.—Our miserable task this time is to report the death of Mr. Joseph G. Eastland, whose death was the sequel of a swift stroke that beset him some months ago; in fact, the striking down occurred in August last. Between then and the last, his time on earth was uncertain, and only the stern spirit that moved his life always is to be credited with the prolonging of a career that virtually ended when Mr. Eastland was brought to bed at the Palace Hotel, in San Francisco, last August, suffering from a stroke, which his years bid his relatives and friends to fear for the worst. Unhappily, their forebodings were realized, and he passed away, quietly and watched, on the night of November 23d, and in his demise was ended the life of a resolute, reasonable and honorable gentleman. Possibly the marauders of the gas business will uncover fault to us for speaking reasonably and respectfully of our dead, for deceased always had courage enough to defend that which he owned, be it gas property or other material worth, but whether our verdict wants for aught in respect of his pride in ownership, the fact remains that Mr. Eastland never looked for more than his part of a fair profit. In other words, while taking that which fairly belonged to himself, he never sought to add to his worldly bulk unfairly. This preface brings us to the life's history of deceased, and a sufficiently varied one it is. Deceased was born of a military race, having first seen daylight in Nashville, Tenn., October, 1831, his father being Major Thomas B. Eastland, who subsequently became a prominent factor in the Mexican war, which disturbed America more or less in the late forties. The Major's family were more or less in line with him during the hybrid Mexican-American struggle, and after the wind up of that blot on American history young Eastland returned to his birthplace, there to complete his education. In 1849, he accompanied his father on a trip, overland, to the Pacific Coast, arriving in San Francisco in November of that year. Father and son established themselves there in a commercial venture, with headquarters on the old "Long Wharf," in 1849, the name of the concern being T. B. Eastland & Son. The quick trading of those "good old days" soon caused the son to part from the father, the boy believing that fortune

awaited him in the gold fields, swamps or mountains; but, parting the history of the son from the father, in 1850, young Eastland accepted a position with the Donahue Brothers, whose Union Foundry in Happy Valley, now in reality a part of San Francisco, was in the boom of a right beginning. His place there was that of an accountant, and his Nashville scholastic training here stood him in good stead, for, when the Donahues organized the San Francisco Gas Light Company, Eastland was in due time (1856) elected Secretary thereof. Some years thereafter (to be precise, in 1878), he resigned that post, to accept the Presidency of the Northern Pacific Railroad, in which oddly-managed concern he was prominent for many years. In 1867, Mr. Eastland, who then became a resident of Oakland, Cal., organized the Oakland Gas Light and Heat Company, of which corporation he continued to be President until death removed him. He was also President of the Stockton Gas Light and Heat Company, and furthermore served on the Board of Directors of the San Francisco Gas Light Company. He was an original member of the Pacific Coast Gas Association, and largely to his enthusiasm respecting the good work that it could accomplish is its present firm organization due. And here we might refer to one of the pleasantest interludes of the meeting of the Pacific Coast Association this year, when Mr. Eastland, having been called upon by President Quilty to give to the Association out of his experience respecting the growth of the gas industry on the Coast, told something of his knowledge concerning the start, establishment and progress thereof. Deceased was prominent in other business developments of the Coast, which may also be supplemented by the plain statement that as he was in its trade and commerce, so was he also in the religious, political and charitable relations of the Coast all that a man honestly interested in these could sustain to them. Mr. Eastland, in 1861, married a daughter of Col. C. P. Lander, and she, with two sons, survives him. The funeral services were celebrated in the Church of the Advent, San Francisco, on the morning of November 26th, the Reverend Bishop Nichols officiating. A feature of the gathering was the presence of the California Pioneers, over which organization deceased presided for two terms. The actual escort of pall bearers consisted of the following named oldest employees in the service of the Oakland Gas Light and Heat Company: Messrs. Thomas Clear, James Nolan, Richard Hanlan, John Sauter, A. C. Beck, John Deuchle, George Kirk and W. D. Smith.

NOTES.—Supt. L. L. Kellogg, of the Sioux City (Ia.) Gas Company, is our authority for the statement that a sensible reduction in gas rates in Sioux City will be ordered on January 1st.——The Northwestern Gas Light and Coke Company, of Evanston, Ills., has filed a certificate declaring an increase of capital to $500,000.——It is said that the plant of the Defiance (Ohio) Light and Power Company is to be reconstructed.——According to the report of the Commissioner of Internal Revenue, at Ottawa, Canada, the total revenue collected during the fiscal year 1895, for the inspection of gas and gas meters, was $17,202.25, as compared with $16,558 collected in 1894. The total expenses were $20,773, as against $21,775 expended during the previous year. Ottawa gas was tested 22 times during the year and was each time found to be pure and well above the standard of illuminating power. Two hundred and six gas meters were inspected, three of them were found correct, 33 too fast, and 167 too slow. Two hundred and three of them were subsequently verified, and three rejected.

Calcium Carbide.

At the annual meeting of the German Electro-Chemical Society, Dr. Borchers exhibited an apparatus by which he not only succeeded, nearly ten years ago, in preparing calcium carbide, but also showed that all the oxides which were regarded as irreducible could easily be reduced by the action of carbon. It consists of a small chamber or furnace of firebrick, through the walls of which pass thick carbon rods 40 mm. in diameter. Inside the chamber these are connected by a thinner carbon rod, 4 mm. in diameter and 40 mm. long. The furnace is fed with a mixture of lime and carbon.

The action is not electrolytic; the effect of the current being simply to heat the lime to a temperature at which it is reduced by the carbon. An E.M.F. of 12 volts and a current of 90 amperes is used. The current may be either direct or alternating; and by diminishing the length of the thinner rod calcium carbide can be produced with an E.M.F. of only 1 volt, so that electrolysis is out of the question. The reactions which take place are: (1) $CaO + C = Ca + CO$; (2) $Ca + C_2 = CaC_2$.

The above reactions are supposed to have been discovered by Moissan and Wilson, but the author refers to publications by Wöhler (1862) and himself (1891).—*Jour. Soc. Chem. Ind.*

Carbureted Water Gas Without Oil: A Study in Practical Gas Making.

[Prepared for the JOURNAL by MR. FREDERIC EGNER.]

When, during the past summer, the price of gas oil was advanced, in our case, 33⅓ per cent., thereby adding 10 cents per 1,000 cubic feet to the cost of making gas, "without any effort on our part," we at first went back to making a mixed (coal and water) gas, as a possible remedy, with decidedly encouraging results; and we also tried making water gas enriched with cannel instead of oil gas. Now, this was not a new thing in the writer's experience, and likely it would not be unknown to many of the readers of the JOURNAL; still, as the matter might be of general interest, the facts are given.

The works are provided with one set of the improved Lowe double-superheater type of water gas apparatus, a double set of the Granger-Collins kind, and a complete, good—though not modern—coal gas plant, besides ample purifying and storage capacity—especially so in respect of the latter. The water gas goes from the scrubber and condenser of the generating apparatus to a primary or relief holder, from which it is taken by an exhauster and pushed through a second condenser, scrubber, the purifiers, station meter, and into the holders. The coal gas goes direct from the hydraulic main to the exhauster, where it meets, at the inlet, the water gas from the relief holder. The speed of the exhauster is regulated by a home-made but absolutely reliable and effective governor, and the pipe from relief holder to exhauster is provided with a convenient valve. These simple details are given because it is believed they will conduce to a clearer understanding of that which is to follow.

Upon a certain morning, having then on hand more finished gas than could be used in the town for the next 24 hours, we started our trial of making carbureted water gas without oil. We had in action 4 benches of fives making coal gas, and had our relief holder (previously completely exhausted) filled with blue water gas; that is, water gas made from the decomposition of steam, by means of incandescent retort house coke, without oil, in a Lowe-Collins water gas apparatus. To produce 1,000 cubic feet of the above described uncarbureted water gas required 60.6 lbs. of gas coke, including fuel used under boiler—carbureted water gas requires, in our case, about 18 lbs. less. It was also found that, instead of making an average of about 4,580 cubic feet of gas per run in each generator, the quantity was reduced to an average of 3,140 cubic feet, or from 15,600 cubic feet per hour for the set to 13,200 cubic feet per hour—let it be well understood that no oil whatever was used in making the blue gas.

Our custom in making coal gas is to draw and charge as many retorts in several of our four benches each hour as would be equal to one bench together; and this system possesses certain advantages for both workmen and the Company, be the works large or small, the separate mention of which, however, may be omitted at this time. We commenced charging the retorts with a reduced weight of cannel, two hours before beginning to mix the gases, and then opened the valve between the relief holder and exhauster until the Lowe jet photometer nearby, and used for the purpose, indicated 22.5 candle power. It was found that, with a combination of 43.6 per cent. of cannel and 56.4 per cent. of the blue water gas, the above average illuminating power could be easily maintained, while at the same time practicing the revivification *in situ* method in our purifiers.

It may be remarked, *en passant*, that we have run our purifiers for over seven months without once raising the covers, and that is going pretty close to purifying in closed vessels; and the only cost on account of purification was the first cost of the material. What that was is of little consequence, since the whole thing hinges upon the manner of using what one can buy or make as may be most convenient or cheapest. But, to return to our subject.

The cannel used yielded something like 23 gallons of tar per ton, which tar is worth 5 cents per gallon, to burn in lieu of coke, whatever it may be worth to sell. We are obliged to gauge the value of our tar by its fuel value. This cannel also produced 1,100 lbs. of really first rate coke per ton, besides considerable breeze. The coke produced was more than was required for fuel in benches and under the boiler, which, of course, is not saying much; but, please remember that our benches, though good, were not by any means modern. In consequence of this, perhaps we did not obtain the yield of gas per pound which the cannel was said to contain. We have no means of utilizing our ammoniacal liquor, and hence this valuable by-product goes to waste, which is, however, in no way the Superintendent's fault.

It was stated that we use gas coke in our generators, wherefore the question naturally may be asked, "How much is that worth?" We

find it to be worth at least as much as good anthracite would be to us; and although that might be the ready answer given, it might not be entirely correct. Let us put it this way, "How much does gas coke cost the producer?" Suppose we were to figure, for example, as follows:

A thousand cubic feet of (?) candle power carbureted water gas might cost us, for material alone, say 38 cents. Remember, gas oil is away up in some sections of the country. Now, a ton of a certain kind of coal might produce, say, 9,000 cubic feet of same candle power gas as the above named sample of water gas, hence the gas from this ton of coal is worth 9 × 38 — 90 (cost of labor to produce) = $2.52. The same ton of coal will produce 14 gallons of tar, which, at its value to burn, is worth 5 cents per gallon, or 70 cents. We now have $2.52 + 70 = $3.22 of value obtained from the ton of coal, which, in this supposable case, cost us to begin with just $3.05. This same ton of coal may yield 1,300 lbs. of coke, of which 35 per cent. may be used in production, and we have left 845 lbs. of coke, which has not only cost nothing at all, but actually (?) came with a profit of 17 cents to boot.

Those figures ought to be gone over by acetylene enthusiasts or others, with whom the former, however, should not be classed, who periodically appear with gas-for-nothing schemes.

This experiment has demonstrated to our satisfaction that carbureted water gas can be made without oil. There need be no apprehension that the gas will stratify in the holder. The verdict of many of our consumers, after using this gas, may be described by some of their exclamations next morning, such as, "What have you been doing with your gas?" "We never have hitherto had such good gas!"

Gas Exhausting and Condensing.

[A paper read by Mr. C. C. Carpenter, of Vauxhall, England, before the Southern District Association of Gas Engineers and Managers.]

As its title implies, the present paper has been written with a view to the consideration and discussion of what are ordinarily the first two stages in dealing with coal gas after it leaves the foul main of the retort house. Though I am aware this order is not invariably adopted, yet in those cases where washing is antecedent to the exhauster, the arguments about to be adduced would apply, but still more forcibly; and therefore their consideration may for simplicity be neglected.

Condensers, washers and purifiers were essential features of gas making plant long before exhausters were thought about, and doubtless in the very early days of the industry their order was thus determined, and for obvious reasons. So, too, with the exhauster; its proper position appeared to be after cooling, and before the washers through which its power could be best utilized to force the gas. Since the time when this order was determined, however, very much greater attention has been bestowed upon maintaining a higher and more constant illuminating power without the use of so great a proportion of enriching material; and one of the factors in bringing this about has undoubtedly been the continual separation of the tar from the gas. Tar so treated is admittedly poorer in benzol, by which the gas is correspondingly enriched, though it would be difficult to attach a definite candle value to the altered conditions. If this tar separation is thoroughly carried out, very little comes forward to the exhauster; and what does is so charged with naphthaline as to have a very buttery or cheese-like consistency. It is quite inefficient to provide the necessary lubrication for the working parts of the exhauster, and this has to be supplied by the addition of oil in more or less regular quantity.

There is some trouble in finding a suitable oil for this purpose, as the majority do more harm than good, by throwing down pitchy matters from the tar. After many trials I found a mixture of pure colza, tar oil and naphtha the best for the purpose. The oil is fed in regularly by sight-feed lubricators, worked from a fixed head of water from a tank placed above the engine room. Even then, however, the waste oil, which is very sluggish, has to be flushed out from the exhauster connections by warm liquor, and the exhausters require careful and regular cleaning at comparatively frequent intervals. Before the practice of taking off the tar came into vogue, exhausters would run for several years without opening, and with the use of very little oil.

It was found desirable this year to remove certain portions of the plant at the Bankside works of the South Metropolitan Company. Its disposition was such that the foul main from the retort house ran through and past the engine room to the condenser, thence back to the engine room, and returned past the condenser to the washers. In order to continue gas making, it was necessary to fix temporarily an exhauster, and the simplest way of doing this appeared to be to cut the foul main at the engine room, and interpose the exhauster, the outlet from which ran on to the condenser. This was done at the beginning of August, since when the exhauster has been at work drawing hot gas (at about 140° F.), and forcing it through the condenser and following plant. Since it started, not a drop of oil has been used for lubrication, and the working parts, when the cover was removed a few days ago, were found to be perfectly free and clean, save for a coating of very thin fluid tar. That these parts worked with a minimum of friction is also confirmed by the readings of the inlet and outlet thermometers, the latter of which has been only slightly the higher.

As far as the working of the exhauster is concerned, I think therefore that its best position is on the inlet of the condenser, instead of the outlet. But there are weightier reasons than this. I have in my mind a gas works where the washers as well as condensers were on the inlet of the exhauster, and where sulphur purification was rendered impossible by the infiltration of air. At more than one London works, when difficulty with sulphur compounds arises, the first steps taken are to examine the plant for air leakage between the exhausters and the retort house. Speaking of another works where it was the custom—and a most desirable one—to stop on Sundays, one of our most eminent engineers told me that it was his duty as an assistant to put this part of the plant under pressure every Monday, so that drawn joints or other air leaks would be at once detected. It is my own practice to do the same whenever any difficulties with illuminating power or sulphur arise.

But is it necessary to run this ever recurring risk? Why have any part of the apparatus working at a pressure below that of the atmosphere when it works at least equally well, and all danger from air leakage is obviated, if the exhauster is arranged to draw hot gas direct from the retort house foul main? It will, of course, be seen that exhausters either of larger capacity or run at a higher speed would be required. A cubic foot of gas at 70° F. becomes 1¼ cubic feet at 140° F. But this would be more than counterbalanced by the advantages set forth, to which may be added the increased rate at which the tar would be condensed by reason of the additional pressure to which it would be subjected.

Mention has been made earlier in the paper of the Sunday "stop," now almost universal in London. It has been urged as an objection to this that it necessitates the changing of so many valves, that it is more trouble than it is worth. This arises from a misunderstanding. A bye-pass governor fixed between the inlet and outlet of the exhauster, and weighted to give (say) ½ inch of pressure on the retort house, is all that is required; and the inlet of the exhauster is the only valve it is necessary to close. The only valid objection to the Sunday "stop" is in the disposal of "light" gas. But all trouble on this score is entirely obviated by the use of such enrichers as the Clark-Maxim, Kemp, Price, and others.

The concluding portion of this paper may be not unfitly appropriated by a few remarks upon condensing. As with exhausting, so too with condensing, taking off the tar has resulted in a considerable modification of the part played by the apparatus. At any rate, as regards Newcastle coal, the increased production of naphthaline is unfortunately connected with modern practice in the economical production of coal gas. Pending a much desired investigation into the circumstances of its formation in the retort, it behooves us to take all precautions that it does not become an unmitigated nuisance to our consumers. Hydraulic main tar will, at a temperature of 130° F., dissolve upwards of 70 per cent. of naphthaline. So that it will be seen what a powerful factor in removing this is eliminated by using liquor seals in the hydraulic mains. It is in the condenser, however, that the excess of naphthaline over and above what the gas will carry at normal temperatures should be removed. Indeed, were it not for this troublesome hydrocarbon, condensing might, perhaps, be dispensed with altogether. The fundamental difference between the serpentine or worm condenser and the vertical type (whether air or water cooled), is that in the one case the condensed fluids travel throughout the entire length, while in the other, each leg or each pair of legs is separately drained, and the products run straight away out of further contact with the gas.

In both cases naphthaline will be generally found in the outlet portions, and in larger quantities in the vertical than in the serpentine type, since the solvent tar is more frequently drawn off. In order to economically dissolve this naphthaline, I arranged one of the condensers at Vauxhall so as to be reversible. When the outlet became partly choked, it was made the inlet. The tarry vapors of the hot inlet gas dissolved the deposit, which was quickly run off through the seals. The arrangement has answered very well, and I had hoped to have an adaptation of it at work at Bankside sufficiently long to have laid be-

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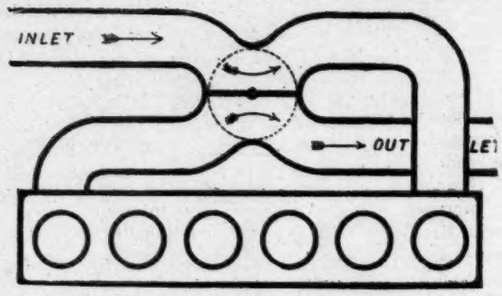


Diagram of Reversing Arrangement of Condensers at Bankside.

The four-way valve, showing by dotted lines, on being turned one quarter round, making the diaphragm vertical, would reverse the current of gas through the condensers.

fore you some more exact data as to the quantity removed. The diagram shows the reversing arrangement, which is simply a four way valve by which the condenser (in this case a vertical one) can be handled as described.

Before bringing to a conclusion this brief sketch, in which my object will be attained if I have laid the foundation of a good discussion, I should like to add one remark as to the practice of burying underground

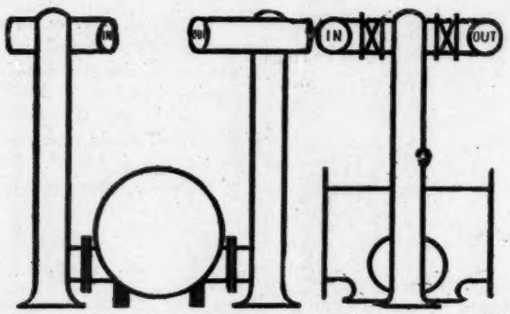


Diagram Showing Overhead Mains and Exhauster Connections at Bankside.

the various mains and pipes on a gas works. Would they not be better overhead as much as possible, where they can be examined and cared for, instead of hidden out of the way? We should not treat steam pipes in that way; why, then, gas mains?

Discussion.

Mr. T. May (Richmond) said the paper was an interesting one, and it seemed to bear principally upon the question of naphthaline. Some time ago he found it practically necessary, in his works, to abolish the condenser; and he ran his exhausters at a somewhat similar temperature to that mentioned by Mr. Carpenter, with corresponding results. They had had no trouble from the sticking of the exhausters, and, as a matter of fact, his exhausters had not been opened for the past three or four years. As they were running all right, they left well alone. In his paper Mr. Carpenter seemed to recommend condensing as a new way of getting rid of naphthaline. This was a very important point. But he (Mr. May) could not say that they found the naphthaline trouble any greater from the fact that, to a large extent, they had done away with their condensing; and this was rather contradictory to Mr. Carpenter's experience. He supposed Mr. Carpenter had not had the arrangement in use long enough to say whether they felt any benefit in the district from its employment. That was where the trouble came, and there would be the crucial test, because they knew that the changes of temperature had so much to do with the deposition of naphthaline. During the short spell of cold weather a few weeks ago, they were bothered with it in his district; but, as soon as there was a change of temperature, the difficulty disappeared altogether. He endorsed what Mr. Carpenter had said as to a thorough investigation of this subject. If they could only induce someone to take up this naphthaline question, and settle something about it—how it was formed, and why—and introduce to gas managers some means of making gas without so much of it, they would be very pleased to support such an investigation; and no doubt gas companies would subscribe liberally towards the expense incurred in carrying it out. He would suggest to Mr. Carpenter that he would earn their gratitude by bringing about such an investigation. He might add that doing away with the condenser, in his case, had practically raised the illuminating power of the gas ¼ candle.

Mr. Helps said the paper was a very practical one; and, though short, it gave them a great amount of food for discussion. He should like to say a few words on the subject, inasmuch as last winter he made an experiment, which was partly prompted by talks he had had with Mr. Carpenter, and partly due to knowing what Mr. May was doing in this line. For some six or seven months, they entirely dispensed with the condenser at Croydon. This was not exactly what Mr. Carpenter was doing, as he simply altered the position of the condenser and exhauster—practically reversed them. Mr. Carpenter mentioned that one of the main reasons that led him to adopt this principle was the fact that he constantly had trouble with his exhauster. He (the speaker) could not say that they ever had difficulty with their exhauster. It never seemed to stick, and they never had deposits of anything solid or of a buttery consistency such as was referred to in the paper. He (Mr. Helps) used ordinary tar oil for the exhauster, and it ran very well. He must say this, as bearing out the concluding remarks of Mr. May, that they did their exhausting at 120°; and, passing the gas straight into the scrubbers, they obtained an increase in illuminating power of something like ½ to ¾ candle; and as it was only necessary to enrich to the extent of 1 candle at Croydon, it was a question whether they would not be able to do without enrichment altogether. However, they found very shortly that they were getting a serious increase of back pressure in the scrubbers—especially the Kirkham, Hulett and Chandler one. They tried warming the water. The difficulty then was that, instead of being able to extract the ammonia from the gas with 10 or 12 gallons of clean water, they had to go up to 20, 25 and even 30 gallons before the ammonia could be extracted. The consequence was that not only were they using a valuable commodity, water, but they were weakening the liquor to such an extent that their sulphate plant was scarcely capable of dealing with the amount of liquor produced. They had returned to the principle of putting on a condenser, and working in the usual way. He was much pleased with the latter part of Mr. Carpenter's paper, in which he suggested the reversal of the inlet and outlet of his condenser. Last year, at Croydon, they started a new retort house and a new condenser; and they had had from time to time to throw it entirely out of use, simply because it got choked—principally at the cooler end—with pitchy tar and naphthaline. He thought he would try to get out plans for putting into practice some such idea as Mr. Carpenter had described, as it seemed to be a step in the right direction. In connection with the remark by Mr. May, that it would be a good thing if someone would take up the question of investigating this naphthaline bother, he should like to refer to a matter that had been before the gas world for some little time. They had, he thought, lost an opportunity of starting a body of some kind by whom such investigations could be carried out. There was—he might say almost there is—a small gas works on the market that could be bought for a mere song. He hoped they would not think he was speaking personally in this matter; but, if such works could be taken up by a few men not as a commercial venture, but for scientific purposes, he was convinced that a great deal of good would result. He heartily wished someone would take this matter in hand.

Mr. D. Irving (Bristol) remarked that the difficulty Mr. Helps had mentioned with regard to the removal of the ammonia after he had done away with his condensers, was the very trouble that one might anticipate. One suggestion that he would venture to make for dealing with the difficulty of the condensers stopping up at the cool end, and one which had been adopted at the works under his care, was to carry a 2-inch pipe to the top of the condensers, and from that pipe run ¼-inch pipes into the first three or four legs of the condenser, and periodically pass a quantity of liquor through. This he found was quite efficient in keeping a set of condensers (which were previously a great trouble) perfectly clean, and in working order. The condensers were large in proportion to the work they had to do, and they previously had the difficulty Mr. Helps had explained, which necessitated, every now and then, that the condensers should be put out of action to clean them, in order to get the gas through. It was two years since the arrangement he had described was adopted, and there had not been the slightest difficulty, although the condensers had been in continuous work.

Mr. A. F. Browne said he supposed the point was that the naphthaline must come down out of the gas. Hitherto, or until a comparatively recent period, the tar, having been allowed to flow with the gas, had absorbed the naphthaline, and carried it away to the seals; and there has been no further trouble so far as the removal of naphthaline was concerned. They were all wishful of getting rid of the tar at the earliest spot, or at the highest temperature, because it not only absorbed

the naphthaline, but carried down with it the other hydrocarbon vapors they were so desirous of retaining in the gas. He believed it would be possible to assist the retention of the naphthaline vapors by enriching the gas while it was hot; but he was not prepared to say whether it would pay to do it. Undoubtedly, if they added a hydrocarbon vapor that had a high vapor tension to coal gas, it would assist in retaining those hydrocarbon vapors which existed in coal gas at a lower vapor tension. But the naphthaline, under present conditions, must come down. The point he did not quite see in Mr. Carpenter's paper was, how, in this reversible condenser, in which the temperature at the outlet was such that naphthaline was deposited in large quantities, he could have a sufficiently hot gas to dissolve the naphthaline out.

Mr. Carpenter—The gas at the inlet has the temperature of the foul main 138° to 140°.

Mr. Browne—And it is close to the retort house?

Mr. Carpenter—Yes.

Mr. Browne—And you find at the outlet of the condenser that a large proportion of the naphthaline is deposited?

Mr. Carpenter—Yes.

Mr. Browne—We are not troubled with naphthaline until the gas has passed through, roughly speaking, 200 yards of condensing main.

Mr. Carpenter—That would form the outlet of your condenser—after the gas had passed through that 200 yards of condensing main.

Mr. Browne—I have no current of hot gas to reverse with.

Mr. Carpenter—You would have a current of hot gas when you reversed it.

Mr. Browne—How is your gas hot enough to enable you to reverse the current with effect? That is my point.

Mr. W. E. Price (Hampton) asked what was the average temperature at the outlet of the condenser. He found he did not get any trouble at the outlet, providing he maintained the temperature sufficiently high. This was with a sort of working half way between the suggestion of no condenser and the ordinary method of using a condenser—all of it—without taking any notice of what the temperature might be. By carefully watching the temperatures, and keeping them at from 60° to 70° F.—which meant more often in the winter time not using a condenser at all—he had no trouble in the way of blocking. There was one difficulty he should like to mention; and he should be pleased to know if Mr. Helps's experience was the same—whether, when not using his condenser, he found that, in passing the hot gas on towards the scrubbing and washing plant, his stock of ammoniacal liquor was raised to a temperature whereby he lost ammonia. When he (Mr. Price) was not using his condensers, he found that his ammoniacal liquor was increased to such a temperature that they could notice all about the works that ammonia was being given off by the liquor.

Mr. Botley said it had been remarked that it would be a good thing if someone would undertake an investigation with regard to the naphthaline question. At Hastings, they had been forced to make an investigation for themselves through the trouble it caused. It was a great many years since he had been engaged in finding a preventative for naphthaline on the works; and so far the result had been that the prevention of naphthaline on the works had been accomplished. But they still had the difficulty of naphthaline in the district. Naphthaline on the works could be prevented by keeping a liquor seal, instead of tar; by drawing the tar off quickly; and by condensing mains. They had none in the works or in the condensers now. They used to have; but now they had it in the district, in spite of every precaution. They had a spell of cold weather in October—there was a sudden fall in the temperature, and they had over 1,000 cases in one week to deal with. The result of his investigation had been this: That the trouble on the works was nothing compared with what it was out of doors, with complaints from consumers, and threats to adopt another source of light. He was going to treat the gas as it left the works, with the view of eliminating the naphthaline. His experiments had been in progress for a good time now, and from the results obtained in the preliminary experiments, he hoped to be able to accomplish the desired end. He might also mention that they were putting up a carbureted water gas plant at Hastings; and it was his intention to introduce the carbureted water gas into the foul main. They would have the means of taking it direct away; but he intended to try the experiment of placing it in the foul main with the coal gas, because he was inclined to believe that there was a gain in illuminating power in this way. If some of the tar was taken up by the vapors of the water gas, they would get an increased enrichment. If anything could be done in this way he should be very glad. He might also state that his was a water condenser—not a vertical one. It was erected about eight years ago, and he never had any trouble whatever with it. In his experience with exhausters, he had had the same difficulty of getting an oil that was constant. But recently they had had a great deal of trouble, and had had to abandon the use of tar oil, and to use a lubricant something similar to that Mr. Carpenter had suggested. He certainly agreed with the author that the mains should not be hidden. At his works, if he could not put them overhead, he laid them in channels underground, so that they could be readily examined.

Mr. C. Gandon (Lower Sydenham) said the naphthaline difficulty was, he supposed, one that bothered and interested them all. He agreed with Mr. Botley that, as a rule, the difficulty was not so much on the works as in the district, and, therefore, he did not know that any different arrangement in the condensing plant would get over that part of it. He should be pleased if some member could suggest how they could get rid of the trouble in the district. As to putting the exhauster before the condenser, that was a very old idea. He could remember that even Mr. Beale, in his time, recommended placing the exhauster before the condenser. He recollected that in the works he (Mr. Gandon) was then connected with, it was in that position, and it gave them a great deal of trouble. It was constantly getting choked up with sticky tar. At the same time, he thought that probably in many cases they carried condensation to too great an extent. He endeavored with their condensers to maintain the gas at somewhere about the normal temperature of the atmosphere, and he thought that was about the best thing one could do. If they kept the temperature too high, it interfered with the action of the purifiers; and if it was too cold, it did the same. He experienced no particular difficulty with deposits of naphthaline in or about the condensers or the purifiers. Where they did get deposits of naphthaline occasionally was in the inlets or outlets of the gasholders; but he did not know that the position of the exhauster would have anything to do with that. He should be very pleased if someone could point out the way in which they could deal with the terrible nuisance of naphthaline stoppages in consumers' pipes and services. It had been talked about a good many times, but he did not know that anything effectual had been proposed for it yet. A circular reached him a day or two previously from some people who said they had a perfect cure for this trouble, and that it had been used with the utmost success by the Crystal Palace District Gas Company. (Laughter.) All he could say was he had a keg of the stuff in the laboratory; but they had never used it. They tested it, and found it was chloride of calcium. However, he intended to try it.

Mr. Robert Morton (London) said he rose for the purpose of making two suggestions. The first was that Mr. Botley (who was proposing to treat his gas, before he sent it out, for the elimination of naphthaline) should rather try to treat it so that he carried the naphthaline forward to the burners.

Mr. Botley—I intended to say, retain the naphthaline in the gas or prevent its deposition.

Mr. Morton thought that Mr. Botley had made a mistake. In an investigation as to the cause of the deposition of naphthaline, by a very eminent chemist, it was found that, if the gas was properly dried or desiccated, naphthaline would not become deposited. There must be moisture in the gas before the naphthaline could be deposited. There was the drawback that, to properly dry the gas, and so cause the naphthaline to go forward to the burners, they would require in big works very large apparatus. The other suggestion he had to make was that, if anyone had difficulty with his exhauster, or wished to carry more of the illuminating constituents of the gas forward to the gasholder, he should try the system which Mr. Carpenter had adopted at the Bankside Gas Works of putting the exhauster on the hydraulic main; and he would advise anyone doing this to adopt a bye-pass arrangement. At one large works of which he (Mr. Morton) had charge some years ago, they had a make of from 4 to 5 million cubic feet per day; and the exhauster there was on the hydraulic main, and the condenser was a large vertical one, in two sections. They were so troubled with naphthaline that they were obliged to work only one-half of the condenser and shut the other half off in order to clean it, and as soon as the latter was ready it was time to turn the gas into it and clean the other half. Condensing under pressure would throw down naphthaline, and Mr. Carpenter's arrangement of turning the hot gas into the outlet of the condenser was absolutely necessary if the work was to be carried on with anything like comfort.

The President observed that, like many others who used Newcastle coal, he certainly knew something about naphthaline. In regard to condensation, they had at Southampton foul mains in all the retort houses; and during the recent "snap" of cold weather they entirely condensed their gas in the retort house, and completely shut off the

outdoor horizontal plant. Their exhausters were all on the outlets of the condensers. The primary tar was taken off at the bottom of the hydraulic mains, and this system had been working for some years, and had been improved upon gradually. Notwithstanding the foul mains in the retort houses, they still had their horizontal condensers out-of-doors choked with tarry naphthaline, and as he did not possess a reversing valve to work the inlet and outlet, the condensers were sectionized. Thus he was able to use one or two or half a condenser, or shut one off altogether. They removed the plates at the ends of the pipes, and, putting a disc in, they drew the stuff out by means of a chain or sometimes a crab, and then it would work again for a long time. They found the deposition was at the cool ends of the pipes, where it became thick. They had occasionally to attend to the inlets and outlets of the gasholders, and clean them out by plunging or some other simple means. In certain districts they were much more troubled with naphthaline outside the works than they were in others. His experience was on all-fours with that of previous speakers. During the recent cold weather they had a great number of complaints, not only of service pipes being choked, but mains in different portions of the district; and in some parts they knew pretty well where to go and look for stoppages at certain times of the year. But this season he had had stoppages in mains where he never expected to find them. He was speaking to a professional colleague not long since, and asked him whether he found any naphthaline outdoors, and he replied, "hardly any." He did not, however, know the reason, unless it was that his mains were laid almost entirely in chalk soil. In his (the President's) own district, the soil was gravel, clay, and at places sandy stuff; and according to the nature of the soil did he find the deposition of naphthaline. He supposed that pipes laid in chalky soil were much drier, and therefore any moisture there was in the gas would not have so much influence in causing the deposition of naphthaline.

Mr. Carpenter, in replying upon the discussion, said he should much rather have preferred reading a paper on how to prevent the formation of naphthaline in the retorts. But he was unable to do that, and the one they had been discussing was the next best thing he could manage. It was very evident that gas at the temperature of the hydraulic main must contain considerably more naphthaline (which was extremely volatile at ordinary temperatures) than it could carry at normal temperatures; and, as soon as the temperature fell, it was certain the naphthaline must come down somewhere. As long as they carbonized coal in the way they now did, naphthaline would be produced in the retorts. Whether it was possible to control the temperature at the latter part of the distillation, at which the greater part of the naphthaline was formed, he was not sure; but if anything was done, he believed it would be in this direction—that they would prevent the formation of naphthaline at the latter part of the charge. There was another point touched on by Mr. May. That was the question of naphthaline in the district. Well, he (Mr. Carpenter) would say they had better have naphthaline in the works than in the district. If they had it on the works, they only upset themselves. By maintaining the temperatures, they would have no deposition on the works; but they would have it in the district. Mr. Helps had related his experience of shutting off a condenser. There was a gain in the illuminating power of the gas, but the scrubbers became blocked up. This blocking up was due to the cause he had mentioned—that was, the temperature being reduced, the gas had more naphthaline than it could conveniently carry, and it was deposited in the scrubber instead of the condenser. It seemed to him (Mr. Carpenter) that the best place to part with it was in the condenser, because they could take it out better from there than from the scrubber. Mr. Irving had spoken of the loss of ammonia. That, of course, was a difficulty so long as pure water was used for taking up the final trace of ammonia. In those works where sulphate was made, there was a system of using diluted sulphuric acid to take up the last trace. Mr. Irving stated that he flushed out the condensers with liquor; and he (Mr. Carpenter) had to do the same thing. But his objection to flushing out condensers with liquor was this, that the liquor made streams in the naphthaline through which the gas passed, instead of getting the benefit of the whole area of the pipe. At any rate, that was his (the speaker's) experience. As to Mr. Browne's remarks about enriching hot gas, Mr. Foulis, of Glasgow, had found precisely the advantage in enriching with water gas—quite apart from the making of carbureted water gas—that Mr. Browne had suggested. Mr. Price had spoken of the temperature at the outlet of the condenser. If it was kept high, they would not have trouble with naphthaline; but if it was kept down to something like normal temperature—say 60°, or perhaps below—they would get it. But they had better have it in the condenser than in the service pipes. Mr. Botley had referred to the prevention of naphthaline on the works. He (Mr. Carpenter) should like to ask him how he had prevented it.

Mr. Botley—By drawing off the tar, and by arranging the condenser as you have described.

Mr. Carpenter—You have just as much in the district as ever?

Mr. Botley—Yes.

Mr. Carpenter (proceeding) said there was one other point which had not been touched upon, although he endeavored to lay some stress on it in the paper—that was the question of drawing in air when they did not want it. He was visiting a large works some time ago where they found it absolutely impossible to purify from sulphur compounds, because they drew in so much air, simply through leaks in their washers and condensers. They drew in so much that all the sulphureted hydrogen got burnt up in the first instance. This was the reason why plant of any kind under vacuum should be done away with. If air was wanted, let it be drawn in where, and in the quantity, required; but they ought not to do it in the indiscriminate manner which would often be the case with plant under vacuum. Mr. Gandon had spoken of the difficulty with naphthaline in the district. There, too, it seemed to him (Mr. Carpenter) it was a question of temperature as much as anything else, and if steps were taken to reduce the temperature at the works, he would get the naphthaline deposited there. But his paper was not exactly one upon naphthaline; it was on "Gas Exhausting and Condensing." As had happened in so many cases, however, it seemed to him they had gone off at a tangent. He was pleased to hear the remark Mr. Botley made in reference to burying mains. It would be a good thing if more of the mains were put where they could be seen, instead of burying them underground, where no one knew what happened to them.

Mr. R. P. Thomas (Ware) asked to be allowed to add a little of his experience to the discussion. He was in charge of a small works, where, in his time, they had increased the consumption of gas from 5 millions to nearly 13 millions. He had had difficulty with naphthaline, principally in cold weather. He had 400 consumers; but during the last severe weather, he received only two complaints. He had 130 public lamps; and some of these had been stopped time after time. The remedy he had adopted was naphtha. He had had a tee introduced, with a simple ¼-inch plug, in the rising pipe. Now when the difficulty arose, he had only to take out the plug, and pour in a ¼-pint of naphtha; and by the time they wished to light up, they found the lamp clear.

The Storage Battery or the Gas Engine as an Auxiliary.

[By Mr. Nelson W. Perry, E.M., before the American Institute of Electrical Engineers.]

Whether it is economical or not to equip a central station with an auxiliary storage battery plant, is a question which must be decided separately for each particular installation. Generally speaking, the question will be decided by the character of the load line—a broad-topped curve being the most unfavorable, and a sharp peak the most favorable to storage battery economy. Again, a station having a very light day load may use the battery to good advantage, even though its night load may present a broad-topped aspect.

Aside from purely economic reasons convenience may be controlling, so that it is impossible to state, unless all the conditions are known, whether the storage battery is advisable or not.

The price of the battery is an important element, of course, but less so than popularly supposed, for the space which it occupies and the cost of maintenance may largely overbalance any gain in first cost over the cost of the extra boiler, engine and dynamo.

In regard to the cost of maintenance, manufacturers are willing to guarantee that it will not exceed 10 per cent. per annum, but it is well to understand just what this 10 per cent. means. It means in the first place that if you put in all the battery power that the manufacturer recommends, and take care of the battery exactly as he says, then the guarantee holds good. Under such conditions the manufacturer is undoubtedly safe, but if we install a plant under these conditions, we are pretty sure to find that the economy in first cost of the battery over engine and dynamo has entirely disappeared.

Then it is well to understand beforehand what the 10 per cent. means—10 per cent. of what? The public are given to believe that this means 10 per cent. of the *cost price* of the batteries, and the statement has been freely made that this is what it means.

Some time ago I had occasion to inform myself accurately on this subject, and to this end entered into quite a correspondence with the president of the leading storage battery company of this country. As

regards the guarantee, he wrote me under date of June 18, 1894, as follows:

"We send you by to-day's mail our illustrated catalogue, and would especially call your attention to the question of maintenance as contained on page 11. We undertake, in these cases, to provide renewals when renewals are required at a specific price, with a guarantee that this will not be required sufficiently frequent (*sic*) to exceed an average 10 per cent. per annum. We have every reason to believe from our experience so far, that the actual cost of maintenance when the batteries are used at normal rates will not exceed 5 per cent."

Turning to page 11 to see what this meant I found the following:

"This company is prepared to undertake maintenance contracts according to a scheduled rate of charges, for periods up to 10 years or longer, under which they will guarantee that the total amount paid for renewals during the term of the contract shall not exceed 10 per cent. per annum on the *catalogue* price of the cells specified in the contract. * * * *In all cases of renewal by* contract the old material becomes the property of the company, *and must be returned to their works free of charge for carriage or packing.*" [The italics are mine.]

Since the regular trade discount at that time was 20 per cent. of the catalogue price, and a further discount was offered which made the cost of the batteries comparable with that of an engine and dynamo, the guarantee assumed a very different aspect from that which it bore on its surface. When to this was added the cost of packing and carriage back to the factory, it ceased to be an attractive guarantee, and my calculations showed that in many cases where the storage battery might be recommended, if the guarantee was what it appeared to be, it would not be economical under the guarantee as it actually was.

This petty deception, together with the application of the battery to uses for which it is not adapted, has brought it into an ill repute from which it will take a long time to recover, and for which the manufacturer has only himself to blame.

As before indicated, there are some situations in which either convenience or extreme steadiness of current may be controlling in deciding the question of the use or not of storage batteries. But where the question is one purely of economy, I would not myself recommend their use under any circumstances, simply because there is a still more economical method at hand. I refer to the gas engine. Even if it were necessary to use illuminating gas from the street mains, it would be more economical (considering space and other factors), to take the peak of the load with a gas engine than to install a battery for this purpose. In this case there would be no standby losses and the engine would be ready at a moment's notice to be thrown into service.

It is a fact that has been amply demonstrated by others, as well as myself, that a given number of lights can be produced with half the gas burned in a gas engine that is required to produce them in ordinary burners. The mechanical efficiency of the gas engine is not quite so high as that of large compound condensing steam engines, rarely ever exceeding 83 to 85 per cent., while the latter may go to 90 per cent., but the total efficiency from fuel to the pulley of the gas engine is about double that of the steam engine—reaching 25 per cent. under favorable conditions, whereas, with the steam engine it rarely equals 12 per cent. So that with the gas engine operating at anywhere near its full load, there would be a gain in efficiency, instead of a loss of say 20 per cent. where the battery was used.

As indicating the performance of a gas engine using illuminating gas at various loads, I quote the following figures obtained from a test of a 12-horse power (actual) gas engine.

Actual H.P. Developed.	Gas Consumption Each Actual H.P.	Actual H.P. Developed.	Gas Consumption Each Actual H.P.
12	15 cu. ft.	6	18 cu. ft.
11	15.3 "	5	19 "
10	15.5 "	4	21 "
9	16 "	3	26 "
8	16.5 "	2	30 "
7	17 "	1	48 "

These figures are somewhat better than would be obtained in practice, but go to show that the gas engine compares favorably at light loads with the steam engine under similar conditions.

Thus far I have spoken only of illuminating gas; but the power may be much more cheaply generated by using a fuel gas.

The cost of producers or generators comes to about $11 per horse power capacity—considerably less than the cheapest boiler, and an idea of the space required may be gained from a statement of Mr. J. Emerson Dowson, who, in estimating for a plant of 400-kilowatt capacity, says that if the gas plant is all on one level it would occupy a ground space of 27 feet by 54 feet, but if necessary, all except the gasholder can be placed under or over the engine room. His estimate for such a plant is, including erection, foundations and ashpit for generators, $5,500, or $10.38 per horse power.

These fuel gas generators can utilize advantageously the poorest grades of fuel, and produce from the better grades of anthracite about 160,000 cubic feet of gas of a calorific value equal to one-quarter that of 16-candle power illuminating gas, per ton of coal.

As to the standby losses of the gas producers, this has been very carefully determined in a number of cases. As an illustration I will cite a single case—by no means the best on record.

At Openshaw a generator which supplied gas for from 250 to 300 indicated horse power, was shut down for 41 hours, and the fuel consumption during this time was but 3.9 pounds per hour, or about 1 per cent. When we compare this with the standby losses of the steam boiler, which is estimated by Prof. Kennedy at 10 per cent. of the total consumption in all the boilers, we see how insignificant it is.

A situation usually considered peculiarly adapted to the storage battery is in subordinate or outlying stations where they are charged during the daytime from the central station and act as centers of supply during the nighttime.

But gas can much more economically be distributed to these stations than can the electric current, for Mr. Denny Lane[1] has shown that with ordinary 16 candle power gas, 3,000 horse power can be sent a mile for an expenditure of 1 horse power, or one-thirtieth of 1 per cent. of the power conveyed.

My own calculations show that a 6-inch pipe will deliver 6,000 cubic feet of gas per hour, at a distance of 10,500 feet under 4 inches of water pressure. If this be 16 candle power gas, allowing 25 cubic feet per horse power hour, this quantity represents 240 horse power.

Cast iron pipe 6 inches in diameter, having a thickness of ½ inch, weighs 31.9 lbs. per foot. The total weight of this two miles (nearly) of pipe will therefore be 334,950 lbs. This would be equivalent in conductivity to about 41,869 lbs. of copper. But four miles of copper weighing 41,869 lbs. would be equivalent to about four No. 000 B. & S. wires, which would have a resistance for the four miles of 0.325 ohms. If the charging current were transmitted at 220 volts, there would be required a current of 848 amperes; but a wire having a resistance of .325 ohms will only deliver under a pressure of 220 volts 220÷.325=677 amperes, there would, therefore, be required five No. 000 B. & S. wires to deliver this energy, and the weight of this would be 53,540 lbs.

If the distribution took place at 1,000 volts, the amperes required would be approximately 180. To deliver this at the same distance with a loss of 10 per cent. would require 6,264 lbs. copper, and to deliver it at 1 per cent. loss would require 62,642 lbs., which would cost far more than the pipe and still give less efficient transmission.

I think it would be very easy to prove that the gas engine with fuel gas, would prove a much more economical auxiliary to the central station for taking the peak of the load and the loads amounting to fractions of a unit, than the storage battery, and when we consider the efficiency of transmission of energy in the form of gas, which will permit of the location of the gas generators where land is cheap and fuel easily procured, it seems to me that the plan must commend itself to electrical engineers.

Unfortunately the gas engine business in this country seems to be in the hands of parties totally incompetent to handle it properly, as every one knows who has ever had occasion to seek information from them.

It is probably not too much to say that every attempt thus far made in this country to adapt the gas engine to electric lighting has proved a failure. Our own manufacturers either do not know what their engines are capable of doing, or else they are afraid to make public what they will do. I believe there is not a single manufacturer who has a printed price list, and my own experience and that of others whom I know has been, that it is impossible to get prices quoted until the manufacturer or his agent has been thoroughly satisfied of the exact purpose for which the quotations are desired. Information of any kind is almost impossible to get, and guarantees of performance, when given, are worthless. To such an extent is this true that nearly all, if not all, the recent large orders for gas engines have gone abroad, where the business is conducted on business principles.

In England, Germany and France the gas engine has come into extensive use in isolated lighting, and already has been adopted with satisfactory results in several central stations of considerable size.

When the business is properly handled in this country we may expect to see the gas engine make its way rapidly in the lighting industry here also, for it has merits which need only to be known to be appreciated.

1. *Electrician*, Oct. 9, 1891.

The Semet-Solvay Coke Oven System.

The *Engineering and Mining Journal* publishes the following respecting the matter named in the heading:

The accompanying illustration shows a section and some details of the Semet-Solvay coke oven, for the recovery of by-products. The general principle on which this oven is constructed is that of the continuous recuperation of heat, and in practice excellent results have been obtained with it.

In general arrangement the ovens are grouped together, the combustion gases being led from the side flues of the ovens through the bottom flue into a main flue, and passing from thence through the boilers into the chimneys. The coke is pushed out of the ovens by means of two steam rams, which are removed from one oven to another by an endless chain running along the ovens, driven by a capstan placed in the engine house. This arrangement permits the working of all the ovens with one single ram in case of breakdowns. These steam rams receive their supply of steam from the boilers by means of a pipe line placed along the ovens, which is connected with the rams by movable elbow joint pipes.

The gases disengaged from the coal during the coking process pass first into a hydraulic main put up on each set of ovens. From there they are led through wrought iron pipes to the condensers, whence they are drawn through the exhausters, and forced through the washers, back to the ovens. The peculiar construction of the hydraulic main obliges the gases to bubble through a small depth of water, whereby the cooling of the gases is greatly accelerated and the formation of hard tar is prevented. The condensers are double jacketed, with continuous water circulation.

The flues in which the combustion of the cooled and purified gases takes place, and which, in other systems, are placed in the brick walls of the ovens, are here quite independent of them, and can consequently be renewed (which may be necessary after a few years) or repaired without touching the brickwork itself. For this purpose the flues are made of retorts with thin sides fitting one into the other and forming a complete and tight circuit. In this way a very solid construction is obtained, with very thin sides toward the coking chamber, which is favorable to the transmission of heat. Experience has shown that this arrangement permits a rapid coking of the coal, and consequently a large production per oven. Besides this, the number of joints between the hollow tiles being reduced to a minimum and fitting into one another, possible leaks of gas between the flues and the coking chamber are also reduced to a minimum, and the yield in by-products is so much larger. The dimensions inside the ovens are as follows: Length, 30 feet; breadth, 1 foot 2 inches on the side of the steam ram and 1 foot 3 inches on the other side; height, 5 feet 8 inches. The brick walls are two bricks thick, or 16 inches, and the thin sides of the tiles or retorts 3 inches. The arrangement of having heating flues entirely independent of the brick walls and arches of the ovens makes repairs much easier and less costly than in ordinary ovens, even if they were more frequent than they actually are. In fact, the ordinary ovens have to be altogether pulled down and reconstructed after about 10 years' working, whereas with the Semet-Solvay system it is sufficient to replace the independent side flues, which does not cost more than $100 per oven. The ovens can be repaired one after the other when required by putting out two ovens only, one on each side. Tiles now in use at Havre, in Belgium, have already lasted four years.

In these ovens it has been sought to avoid all causes of loss of heat in order to obtain the most favorable results from the combustion of the gases, and an even distribution of heat in all parts of the oven, by which means there is a quick and regular coking of the coal. For this purpose the brickwork over the bridges has been increased to a thickness of 4 feet. The cast iron doors of the ovens are protected against the weather by wrought iron doors, which also prevent the cooling of the outside ends of the ovens.

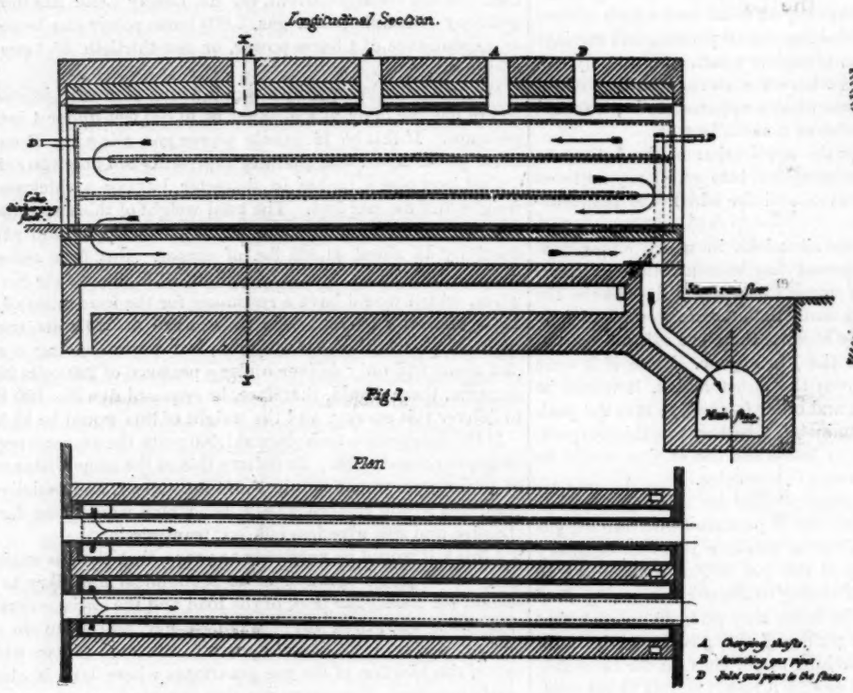
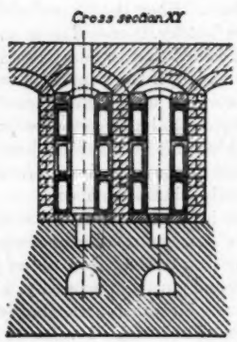


Fig 1.



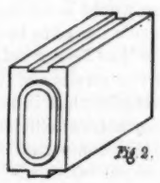


Fig 2.

The heating arrangement is shown in the drawing. Part of the gas is introduced in the upper range of hollow tiles on the side of the steam ram, and, passing successively through the intermediate and lower ranges, the gas descends to the flue under the floor of the oven. Another part of the gas is introduced on the opposite side into the middle range. The object of this division of the gases is to avoid overheating certain points and to obtain a better distribution of heat. The air needed for the combustion of the gas is admitted close to the first gas inlet, and is previously heated to a temperature of 392° to 572° F., by the brickwork under the floors of the ovens, in the following way: Beneath the flues under the floors are channels through which the air, drawn by the chimneys, is made to pass before entering the upper range of hollow tiles where the first introduction of gas takes place.

The combustion of the gases in these ovens is so well managed that, without having any direct heating with coal, not more than one-half of the gas obtained by the distillation is required for heating the ovens, even when the coal only contains from 16 to 17 per cent. of volatile substances. The fireplaces under the floors of the ovens, which have been so far the necessary complement of ovens with recovery of by-products, could therefore be entirely done away with.

In consequence of the large excess of gas at disposal and the method of regulating the combustion of the gases, this is up to the present the only system of oven which permits the exact regulation of the temperature

of the ovens, and its maintenance at the desired point according to the nature of the coal to be distilled. At the same time the coking is exceedingly regular, as the amount of heat at disposal always allows the regulation of the ovens according to circumstances.

Every ingress of air into the ovens has been carefully avoided. The doors are designed in such a way as to enable an easy and efficacious luting. All the other openings, such as the charging shafts and the cleaning holes in the ascending gas pipes, are closed by covers with faced joints, maintained in place by springs, thus avoiding any further luting. The coke coming out of the oven does not show the slightest trace of combustion, and thus proves that the oven is thoroughly air tight.

The gas enters the heating flues through openings adjusted in such a way that each oven receives the same quantity of gas. Dampers between each oven and the main flue are set so as to give an equal draught in all the ovens. This makes the working very regular; the different sets of ovens are regulated by the pressure of the heating gas in the distributing pipes, which pressure can be maintained at the desired figure by means of a valve through which the gas passes, and by dampers at the foot of the chimneys. The temperature of the burnt gases at the bottom of the chimneys is hardly 392° F., while the ovens themselves work at a very high temperature.

The History of the Lathe.

It does not seem to have been noticed that a most important centenary, from an engineer's point of view, has been allowed to pass by without remark. We allude to that of the invention of the slide rest by Maudslay, in 1794, an invention which it is safe to say is one of the most important and epoch-marking steps in the world's industrial history. Practically all we know on the subject is to be found in Nasmyth's "Essay on Tools," in the third edition of Buchanan's "Millwork," which appeared in 1841. This contains a drawing supplied by Francis, one of the sons of Joseph Bramah, headed, "Bramah's Original Slide Tool, 1794." It should be explained that Maudslay was in Bramah's employ at that time. As might have been expected, the appliance shown in the drawing differs a good deal in appearance from the slide rest now in use, being composed of somewhat slender looking superposed frames, which do not seem adapted for heavy cuts. This rest was stated to be in use at the date of the drawing. It would be interesting to know the subsequent fate of this important relic, which should have found its way into our national collection, which again should be in some place more readily accessible to engineers than is South Kensington.

The invention was not patented, and it has been suggested that Maudslay derived the idea from the construction of some boring mills, imported from Holland, at the Royal Arsenal, Woolwich, where he had served as a youth, and with which it is considered he must have been acquainted. However this may be, there can be no doubt of the importance of Maudslay's invention and of his having been the man for the hour, although, indeed, the slide principle did not at first spread so rapidly as might have been expected.

A forerunner of the slide rest in the form of a guide for a hand turning tool is, as is pointed out by Herr Fischer in a recent number of the *Zeitschrift des Vereines Deutscher Ingenieure*, to be found in Hulot's memoir, "L'Art du Tourneur," in vol. xxiii. of "Description des Arts et Metiers," 1775, in which, at page 375, we read: "Barre de Tour d'une nouvelle invention servant pour tourner facilement des ouvrages parfaitement cylindriques."

A guide bar of rectangular section fixed parallel to the axis of the lathe carries a slide adapted to be moved to and fro along its upper surface, and engaging by means of two projecting tongues with channels formed in the vertical side of the bar. Across the top of the slide is a groove for the tool, which is held down by a spring, and has an adjustable stop clamped on at the required point to limit its motion toward the work. The tool is to be moved to and fro by hand. This appears to have been the first application of the guide principle to the tools of turning lathes. Maudslay went considerably beyond this, in producing a compound slide and in giving motion to the parts thereof by means of screws, operated at first by hand, and afterward automatically. The first account Herr Fischer has been able to discover of a self-acting slide rest is in one of the 1823 volumes of the *Jahrbuch des Weiner Polytechnischen Institute*. This contains a drawing clearly showing a slide rest, operated by a leading screw geared to the mandrel. Maudslay had, however, some years before this arranged his slide rest for a self-acting motion, as appears from a plate dated 1815 in Dr. Rees' "Cyclopædia," in which is shown gearing for connecting the screw of the lower slide to the mandrel; change gearing with fixed centers, as well as the slotted radial arm or "banjo plate" arrangement, is described and shown for cutting screws differing in pitch to the screw of the slide.

The lathe by Clement, described in the "Transactions" of the Society of Arts in 1828, shows some marked developments. It is a brake lathe with a rudimentary form of back gear, overhead countershaft and automatic variation of the speed of the mandrel for surfacing, by means of a pair of oppositely arranged conical rollers along which a driving belt is traversed; a self-acting movement can be imparted to the screw of the lower slide; the bed and slide faces are flat.

Fox, of Derby, about 1830, was using a rack and pinion arrangement for traversing the slide. In the German periodical referred to above attention is directed to full descriptions and drawings of lathes made by Fox for the Konigliche Gewerbinstitute at Berlin, which are to be found in the *Verhandlungen des Vereines zur Beforderung des Gewerbfleisses* for 1831 and 1832. The reference may be of value to the future historian of the subject. One of these lathes, a face lathe, has the mandrel driven by a long train of gearing, any one of the shafts of which may carry the driving pulley. An endless chain working under the bed, and driven from the mandrel by spur and worm gear, is used for traversing the slide in the screw cutting lathe described as having been in use by Gallimores of Sheffield, in "Manufactures in Metal," 1833. Two of the spur wheels were to be changed to vary the pitch of the screw cut, the mandrel is driven from a spindle at right angles to it carrying a stepped pulley and a bevel wheel adapted to engage either of the bevel wheels on the lathe spindle. Stepped pulleys grooved for catgut bands were in common use before that date.

Whitworth's first patent, in 1835, has the slide rest traversed by a leading screw fixed in the bed. It has back gear, open and crossed belt reversing gear, overhead countershaft and change gearing with the "banjo plate."

The history of the steam engine as a locomotive, and for stationary and marine purposes, has been pretty fully dealt with in text books and by correspondence and otherwise in the columns of the engineering press, but considering their immense importance, and the pre-eminent position that English engineers have taken up in their origination and development, it is very remarkable how little has been done with reference to the history of lathes and other machine tools. There must be among our readers, says the London *Engineer*, many whose minds are stored with valuable and interesting reminiscences which, if made public, would form a most important material for the history of the subject.

Paint as a Preservative for Iron.

By Messrs. E. A. Custer and F. P. Smith.

At the November meeting of the Engineers Club, of Philadelphia, the President (Mr. George S. Webster) directing the proceedings, the paper of the evening, on "Paint as a Protection for Iron," was contributed by Messrs. E. A. Custer and F. P. Smith. The paper which was read by Mr. Custer is as follows:

It would appear from past experiments that bright iron does not rust when exposed to a dry atmosphere of pure oxygen and carbonic acid gas, separate or mixed. After the rust has once commenced only the slightest trace of moisture is necessary to continue this chemical action, which is probably due, not only to the corroding influence of the rust already present, but also to its power of absorbing oxygen and condensing moisture. Any covering that is absolutely impervious to moisture will when applied to clean iron, prevent rust under atmospheric conditions in which corrosive elements are wanting. The protective covering that is to meet these conditions must be cheap and easily applied, and a paint or combination of paints seems to be the logical outcome of the problem involved.

The requisites of a good paint for the preservation of iron and steel are stated by Mr. Woodruff Jones, A.M., to be:

1st. It should firmly adhere to the surface and not chip or peel off.

2d. It must not corrode the iron, else the remedy may only aggravate the disease.

3d. It must form a surface hard enough to resist frictional influences, yet elastic enough to conform to the expansion and contraction of the metal by heat and cold.

4th. It must be impervious to, and unaffected by, moisture, atmospheric and other influences, to which it may be exposed.

In undertaking to produce a paint, with the above requirements, that would absolutely protect iron, it was early determined that the covering should consist of two distinct elements, the first of which should

possess the adhesive and elastic properties, and afford a safe and elastic base for the application of a second coating that would be hard, elastic, acid proof and absolutely impervious to moisture. There is no paint known that will meet the first requirement so fully as good red lead and linseed oil. The dry film of red lead and linseed oil, however, is porous, and this defect must be remedied by a second coating of paint, which will dry with an absolutely impervious and water proof surface.

It has been justly claimed for red lead that the property it possesses of saponifying the oil—not oxidizing it in its true sense—renders it one of the most valuable pigments for a first coating on structural iron. After numerous experiments, a vehicle was finally selected as affording the nearest approach for an ideal outer covering for iron work.

The pigment was next considered, and it was decided that this must itself be inert so far as iron is concerned; for while it was intended to be used over a foundation coat of red lead, it should be possible to employ it in some cases as a sole protective covering. A material was incorporated in the pigment which enables it to resist frictional action in the highest degree, makes it practically impossible to destroy, and to all intents and purposes absolutely insoluble in any of the known solvents.

One important point that must be carefully considered when the protection of iron is desired, is the presence of mill scale or iron rust. No paint, however good, is worth a cent a ton for the protection of iron when used over mill scale. The absolute removal of mill scale from the iron before it is painted should therefore be specified and insisted upon. In ordinary practice it has been found sufficient to brush the surface of the iron carefully and thoroughly with a good wire brush and then apply the paint.

Attention was then called to the quality of the paint to firmly adhere to the surface of iron when subjected to very high or low temperatures, and some specimens of pipe were exhibited that were first coated when cold with the protective paint referred to, and were then subjected to live steam at a temperature of 340°, then painted while hot with the same preparation, and afterwards dipped in a mixture of ice and salt until thoroughly chilled.

Discussion.

Mr. G. B. Price—Am I right in supposing that the first coat of red lead fills in the pores of the iron, while the second gives a hardened surface?

Mr. Smith—The first coat does not necessarily fill up the pores, but it makes the surface of iron glossy and smooth, and the second coat gives it an enamel surface. The most severe test that we have given our paint is in a place where it has been exposed to the fumes of sulphuric and muriatic acid for nearly four years. It shows no signs of deterioration yet, although the first gloss has disappeared, and a careful examination of the iron, after scraping away the paint, shows that it has been perfectly protected. Ordinary paint, under the same conditions, would not have lasted more than two years. This paint has also been used largely for the protection of smoke stacks and for boiler fronts, where it has lasted for nearly a year. It does not crack under a high temperature. In structural work, the first coat is usually applied at the shop, and the finishing coat is put on after erection, as it would very likely be marred in putting the iron together.

Mr. John C. Trautwine, Jr.—While not bearing directly upon the subject under discussion, it may be of interest for me to state that in applying asphalt paint on a concrete surface, it has been found desirable to dissolve the asphalt in a considerable proportion of benzine or gasoline; in the latter solution the best proportion being 75 per cent. of gasoline. The liquid seems to carry the particles of asphalt into the pores of the concrete, and, when it is thoroughly dry, a thicker coat of melted asphalt is applied. In this way we obtain a very perfect adhesion of the latter material.

Mr. C. D. Rinald—What Mr. Trautwine has said is true of almost all paints. Paint, for protection, should not be too heavy, as it is then much more liable to be affected by mechanical action, such as anything striking against it.

Mr. Smith—So far as the use of benzine on iron is concerned, we have found it objectionable, as it is difficult to obtain it perfectly volatile, so that when it evaporates it leaves a greasy surface, which, though not objectionable on cement or concrete, is disadvantageous upon iron.

Mr. Rinald—The use of red lead as a priming coat to make the protective coat adhere better, recalls to my mind an amusing letter we received some time ago from a gentleman down south. He wrote that it was the custom in that part of the country to allow metal roofs to rust slightly, because the paint would then adhere better. Many builders, indeed, believe in allowing the iron to rust slightly, thinking that the protective paint, applied afterwards, will be incorporated into the iron. I do not think that this can be proven, but I do not see why a paint cannot be made—in fact, there is a paint—that will adhere to the iron without anything under it, even when the iron is very smooth. However, a priming of red lead would certainly be better than a coat of rust.

Mr. E. A. Custer—We had that experience in connection with a couple of buildings last summer. The roofs were made of tin, the front being inclined a half-inch in 10 feet to satisfy our city building laws. We requested the builder to paint it over with red lead, but he replied, "We always wait until it rusts, for then the paint sticks better."

Mr. F. Schumann—Some ten years ago we allowed a man to exhibit at our works a material that he prepared for coating iron with a glossy covering of different colors, which stood the test of being immersed in water and different acids. We bought the secret from him for the composition of the material, which was simply sandrax gum dissolved in alcohol and colored by pigments. We afterwards painted a steam engine with this mixture, which, without pigment, was very transparent, so that the engine always remained clean, and prevented the iron from rusting until it was taken off, about two years after its application, at a cost of nearly $100. Why are there not some good qualities in these vegetable gums for their use in the protection of iron? It stood exposure to steam, gas and moisture.

Mr. Rinald—A similar preparation, largely used for many purposes, is gum shellac dissolved in alcohol. It makes a strong coating, but I do not think a gum will stand exposure to the weather for any length of time. It will crack and peel off.

Mr. Smith—It is, unfortunately, true of almost all vegetable gums which are completely soluble in alcohol, that while they make a good-looking appearance, they are practically worthless when exposed to the weather, and even in the better grades of varnish for wood these gums are never used for that reason.

Mr. Max Livingston—I would like to bring up the point of the comparative difficulty of protecting steel and iron. It has been my experience that paint on iron will last considerably longer than on steel, especially on the outside of steel tanks filled with water. If filled with oil, there seems to be less difficulty; but when they contain water the steel rusts very quickly. The best of paints will chip if over a steel surface, under the same atmospheric conditions where they would last on iron. I should like to know if this can be explained.

Mr. Smith—This, doubtless, is a fact; but the explanation which I must fall back upon is the somewhat lame one that some materials rust quicker than others, in the same way that some materials are more soluble in certain acids than others. Regarding bisulphate of carbon as a vehicle for paint, its fumes have a very bad effect upon workmen using it, and are probably more inflammable than the vapor of any other liquid; and I have known of cases where serious explosions occurred from paints in which it was used.

Mr. Custer—I think that if the surface of either iron or steel is perfectly clean before the paint is applied, iron will not be found to last any longer than steel, so far as rust is concerned.

Mr. Schumann—The absolute removal of scale must be insisted on. We find, instead of using acid baths for this purpose, sand blasts are very efficient and very quick, and make the surface of the iron bright and clean. In the plan that I am familiar with a 3 × 3 angle bar 20 feet long can be thoroughly cleaned with a sand blast in about 5 minutes. It also has the advantage of being applicable to work already riveted together. I think it would be well if those preparing specifications should incorporate a clause requiring the cleaning of the iron and its subsequent inspection before any paint is applied.

Mr. C. E. Wolle—Rosin dissolved in benzine will protect iron from the effects of salt water, as we found by experiment in shipping deck loads of this material. Regarding the rusting of tin roofs before the paint is applied, I think the tin is often exposed to the action of the atmosphere in order to allow the film of oil which covers it when manufactured to be destroyed, and the paint will then certainly adhere better.

Mr. Trautwine—In examining a piece of 6-inch water pipe laid in about 1822, we found it incrusted inside with a layer of material that proved to be chiefly oxide of iron and graphite, so that the internal area of the pipe had been reduced about 20 per cent. Another piece of 6-inch pipe laid 26 years ago, after having been first coated with a protective paint, was examined, and practically no incrustation was found upon it.

Mr. H. J. Hartley—For the last 25 years we have never allowed iron plates to be applied on ships without first pickling them in muriatic acid, washing the acid off thoroughly, and then painting them with red

lead; so that I see nothing new in that. When the ship is ready to launch, a second coat of good red lead and linseed oil is applied.

Mr. John L. Gill, Jr.—Chimney stacks made of No. 14 iron are very common on the boats sailing the Ohio and Mississippi rivers, and are often painted with ordinary coal tar containing a little lime, to neutralize any acid that might be present. Stacks coated in this way have to be renewed about every three years. The first experience I had of red lead being used in this way was on the steamboat "J. B. Williams," built during the war. Two years ago I saw this boat at Pittsburgh, and it still had its original stacks, which had been protected by a coat of red lead and linseed oil applied regularly once a year. This method of protection for smoke stacks is one of the best that I know of. For boiler fronts and similar purposes I know of nothing equal to Bessemer paint.

Mr. Hartley—I think a coating of linseed oil is as good as any paint for the latter purpose.

Mr. Custer—My experience has been that on the smoke stacks of locomotives, for instance, linseed oil gummed and caused considerable trouble.

Mr. Schumann—In the discussion on this subject at our meeting of four weeks ago there seemed to be a difference of opinion as to the efficiency of a cement covering to prevent corrosion of iron. I therefore took the trouble, within the last two weeks, to inquire about this among builders who had torn down old structures built with mortar cement, and some of more recent date built with cement. Their opinions differed, but the majority seemed to be in favor of cement forming a protection for iron.

Mr. H. C. Luders—It would seem to me that the additional expense of cleaning iron in buildings would amount to almost as much as the original price of material, and if so, would it be well to insist upon the iron being so prepared by the specifications?

Mr. Schumann—I think the iron could be cleaned with sandblast at a comparatively small expense after it is placed in the structure. It would probably cost as much as handling the iron and applying the first coat of paint.

Mr. Custer—It should not matter to the designer what the expense will be, if it is made necessary in order to have a building that is absolutely safe. Any structure that is liable to break down in a few years is not worth the material in it.

The Most Economical Cut-Off for Steam Compression.

By Dr. Henry T. Eddy.

Some misapprehension seems to have prevailed as to the precise purport and relation of certain demonstrations that have been given as to the most economical point of cut-off. With a view to clear up this misapprehension the author has recently investigated the question anew, and proposes in the present brief review to state the conclusions to which this inquiry leads when based on the usual supposition that the expansion and compression curves of the indicator card are rectangular hyperbolas. The approximate results thus obtained will serve to make sufficiently clear the points to which it is desired to direct attention, and will leave to a future time certain more accurate, but more complicated methods of obtaining results, which will approximate still more closely to the actual indicator card.

1. Suppose it be required to find the best ratio of compression in case the data given are: The volume of the cylinder, the volume of the clearance, the pressure during admission, the back pressure of exhaust and the ratio of expansion.

This question has been solved in analytical form by Professor Cotterill,[1] and also by Professor J. Burkitt Webb,[2] who has shown that the results may be graphically represented upon the indicator card as follows: Prolong the expansion curve until it intersects the exhaust pressure line, and measure the area thus added to the indicator card. Cut off an area equal to this from the top of the indicator card by a horizontal line drawn parallel to the line of zero pressures; then the point at which this line intersects the vertical clearance line will be a point of the compression curve of best compression cut-off to accompany the given admission line and expansion curve.

It can be shown at once from the analytical results that the ratio of compression thus obtained will always be greater than the given ratio of expansion in case the expansion is incomplete. The same result will be evident to any one who will make the graphical construction just mentioned; and it may be otherwise evident if it be duly considered that the best ratio of compression should lie between the ideal case of complete compression and a ratio equal to the given expansion.

1. Steam Engine, 2 Ed., p. 257.
2. Proc. A. A. A. S. for 1898, p. 119.

2. But suppose, conversely, that we proceed to inquire what is the best ratio of compression in case the data given are: The volume of the steam cylinder, the volume of the clearance, the forward pressure of admission, the back pressure of exhaust and the ratio of compression. The analytical solution of this question leads to results analogous to those previously obtained, which also admit of graphical construction, as follows: Prolong the compression curve until it cuts the admission pressure line, and measure the area thus added to the indicator card. Cut off an area equal to this from the bottom of the indicator card by a horizontal line parallel to the line of zero pressures, then the point at which this line intersects the vertical expressing the total volume of cylinder and clearance will be a point of the expansion curve of best admission cut-off to accompany the given back pressure and compression. It can be shown analytically or graphically or from general considerations that the ratio of expansion thus obtained will be greater than the given ratio of compression.

3. It is evident that neither of the foregoing results is such as to enable us to determine the best relative points of cut-off for expansion and compression. For, if we were to follow their indications and start with a given ratio of expansion, not complete, we should find the best ratio of compression to accompany it to be greater than it is; and if then the best ratio of expansion be found to accompany this compression, that must be still larger; and so on stroke by stroke. This requires that the cut-off for compression and for expansion should become, step by step and stroke by stroke, more and more nearly complete. This conclusion is in entire accordance with our general knowledge of the fact that on the basis on which we are now proceeding, complete expansion and complete compression are theoretically best, and our results so far, show simply that starting with any ratio less than that, we should be led to approach complete expansion and compression step by step instead of changing suddenly. This step by step increase of ratio, however, in a cylinder of given volume involves the admission of a smaller and smaller amount of steam per stroke until complete expansion is attained. But since practical considerations forbid complete expansion, it is evident that such an investigation as has been made does not lead, as has heretofore been frequently assumed, to the solution of the question of the most advantageous relation between the ratios of compression and expansion. The same conclusion as to the applicability of results obtained in this way would evidently hold against a similar investigation based on some other and more accurate law of expansion and compression than that of the hyperbola. The difficulty lies, not in the law, but in the statement of the problem, which should evidently contain limitations nearly as follows:

4. To find the best ratios, both of expansion and compression, when the data are, the volume of the cylinder, the volume of the clearance and the volume of the steam admitted per stroke, together with the forward pressure during admission and the back pressure during exhaust. On investigating this question analytically the best adjustment is found to occur when the ratios of expansion and compression are equal. More work is therefore performed by a given volume of steam admitted, other things being equal, when this adjustment of ratios is made than when the adjustment is in accordance with either of the results previously given. The conclusion here reached will evidently require but very inconsiderable modifications to adapt it to the comparatively small deviations from hyperbolic expansion which occur in practice. The modification needed to give this still closer approximation cannot be given here, but must be reserved for a future occasion.

The World's Tallest Structures.

Machinery says that the tallest chimney was built at Port Dundas, Glasgow, Scotland, 1857 to 1859, for F. Townsend. It is the highest chimney in the world (454 feet), and one of the loftiest masonry structures in existence. It is, independent of its size, one of the best specimens of substantial, well made brickwork in existence. In Europe there are only two church steeples that exceed this structure in height, namely, that of the Cologne Cathedral (510 feet) and that of the Strassburg Cathedral (468 feet). The great Pyramid of Gizeh was originally 480 feet, although not so high at present. The United States outtops them all with its Washington Monument, 550 feet high, and the tower of the Philadelphia Public Buildings, which is 537 feet high.

The Eiffel Tower, at Paris, France, surpasses all other terrestrial metal structures with its altitude of nearly 1,000 feet. The "Great Tower," for London, England, in course of construction from designs of Mr. Henry Davey, C.E., will outtop all metal structures, being built of steel, and its extreme height will be 1,250 feet when finished.

The highest and most remarkable metal chimney in the world is

erected at the imperial foundry at Halsbrucke, near Freiberg, in Saxony. The height of this structure is 452.6 feet and 15.74 feet in internal diameter, and is situated on the right bank of the Mulde, at an elevation of 219 feet above that of the foundry works, so that its total height above the sea is no less than 711.75 feet. The works are situated on the left bank of the river, and the furnace gases are conveyed across the river to the chimney on a bridge through a pipe 3,227½ feet in length.

The highest artificial structure in America is the water works tower at Eden Park, Cincinnati, Ohio. The floor of the tower, reached by elevators, is 522 feet above the Ohio river. The base is 404 feet above the stream. If the height of the elevator shaft be added to the observation floor, the grand total height is 589 feet.

The highest office building in the world is the Manhattan Life Insurance Company, of New York city. Its height above the sidewalk is 347 feet, and its foundations go down 53 feet below the same, being 20 feet below tidewater level, making a total of 400 feet. The foundations consist of 15 masonry piers, and are carried by the same number of steel caissons. The latter were sunk to bedrock by the pneumatic process. The cantilever system was used for the foundation.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE local authorities have renewed the franchise of the Jamaica (L. I.) Gas Light Company for a period of 25 years. It is stipulated that the maximum gas rate shall not exceed $2 per 1,000 cubic feet.

THE proprietors of the Troy (Ohio) Gas Company are completing a comprehensive and well-arranged enlargement of the Company's distributing system.

THE Consolidated Gas Company, of Baltimore, Md., has purchased the fee to the property or land on which is located the building containing its offices. The site fronts South street near Lombard, and its dimensions are 29 feet 3 inches by 79 feet. The seller was the Baltimore Equitable Society, and the reported price was $20,000.

MR. LESTER N. TOZIER, the new Secretary and Treasurer of the Warsaw (N. Y.) Gas and Electric Light Company, has succeeded in convincing the Company that its offices were in the wrong place. At any rate they (the offices) have been removed to spacious quarters in the Crawford and Watson building.

THE proprietors of the Riverside (Cal.) Gas and Electric Light Company will forthwith expend considerable money on plant betterment, not the least important of the improvements to be a storage holder. To provide funds for this work the Company will make a bond issue of $30,000.

MR. WILLIAM TRACY is negotiating for the lease or purchase of the Salina Light and Power Company, of Salina, Kansas.

MR. FRANK J. ORT, formerly of Ironton, Ohio, has been appointed Superintendent of the Hopkinsville (Ky.) Gas Company. He assumed charge on the 1st inst.

THE oft adjourned annual meeting of the Brookline (Mass.) Gas Light Company was again postponed, this time without date.

AT a special meeting of the Board of Trustees of the village of Newark, N. Y., a franchise for the operation of a gas works was granted to Messrs. George W. Muth and Frank D. Burgess. This place is a post village of Arcadia township, Wayne county, N. Y., and is located on the Erie Canal, at the junction of the New York Central and the Sodus Point & Southern Railroads. It is 30 miles east southeast of Rochester, and contains iron furnaces and foundries and two fairly large flour mills. Population, about 4,000.

THE County Commissioners, of King county, Washington, have awarded the contract for the lighting of the courthouse to the Seattle Gas and Electric Light Company, the rate to be the extremely liberal one of $1.50 per 1,000 cubic feet.

A SYLLABUS of the decision of the Hon. J. H. Jordan, Chief Justice of the State of Indiana, in respect of case No. 17,489 (before the Supreme Court, for review from the Appellate Court of the State), which case had for its basis the contention whether or not local authorities of that State had the right to regulate the price that might be charged for a natural gas supply, is appended:

"1. Incorporated cities and towns are empowered to enact a general ordinance to reasonably regulate the supply, distribution and consumption of natural gas within their respective limits corporate, and to require a fee of the Companies for the use of the streets thereof. (Sec. 4, 303, R. S., 1894.) 2. A general ordinance must allow all Companies to use the streets on equal terms and conditions, as the law impliedly forbids the grant of special privileges by special contract or license to any one Company, to the exclusion of others. 3. A town has the right, in granting the use of its streets, to impose such reasonable requirements, terms and conditions upon those accepting the grant, as its own discretion may dictate, so long as it does not restrict its own legislative power. 4. A corporation having accepted the franchise granted by the ordinance, and agreed to be bound by the express terms as to the price of gas, having engaged and continued in the exercise of that privilege, is precluded from refusing to furnish gas to the inhabitants upon the ground that they refuse to pay a price in excess of the maximum rate fixed."

MRS. CIENEGA HUTCHINSON and Richard Hutchinson, her son, have brought suit against their landlord (Jacob Jacobs) and the San Francisco Gas Light Company, the former asking damages in the sum of $20,200, and the latter in the sum of $25,250. The complaint recites that on August 29th, 1895, during their absence, a chandelier was removed from a room in their residence, and that the plumbers failed to cap the service pipe. When the plaintiffs returned home in the evening, one of them ignited a match and an explosion resulted causing severe bodily injuries to both.

MESSRS. WILLIAM M. CRANE & Co., of this city, have been awarded a gold medal and diploma by the Cotton States and International Exposition for their excellent display of gas cooking and heating appliances. The Creole Kitchen, which is a feature of the exposition, and under the control of the Board of Women Managers, was fitted up with gas appliances by the Crane Company.

THE following is taken from the Minneapolis, Minn., *Tribune*, of November 27th: "Alonzo D. Meeds, City Gas Inspector, has reported to the Council Committee on Gas that the quality of electricity furnished the city for its street lights was below the contract requirements, although for the past month there has been a marked improvement. The tests have been three in number, and have been conducted on principles of the most scientific exactness. The contracts between the city and the lighting Companies require 2,000-candle power for every street light. It is a requirement of the contracts, therefore, that there shall be 450 watts of current for every light, as it is necessary to have this amount to produce a 2,000-candle power light. Mr. Meeds made the first test on June 21st. At that time the test developed but 336 watts, against 450 required. Another test was made October 22d, when there were but 326 watts. The last test was made but a few days ago, and the quality and strength of the current had materially improved, there being 443 watts developed, but 7 below the contract requirement. The attention of the Illuminating Company was called to the deficiency, and it is expected that the next test will show full strength. The ampere strength has also been deficient, but is now on the increase."

THE proprietors of the Owego (N. Y.) Gas Company are again considering the feasibility of adding an electric annex to their possessions.

A RECENT issue of the Elmira (N. Y.) *Advertiser* had this to say: "The Public Improvement Committee of the Common Council investigated the franchise of the Chemung Gas and Electric Light Company at a meeting yesterday afternoon—Nov. 25th. Mr. Ferdinand McKiege, of New York city, was in attendance. After considering the franchise as presented by the new Company, and also taking into consideration several vague rumors regarding an alleged conspiracy to compel another illuminating Company to dispose of its plant, it was decided not to grant a franchise to the new Company until the franchise presented had been changed in several points to protect the city and the existing illuminating Companies. One of the most important features of the franchise acted on by the Committee was that the new Company be obliged to give a guarantee that it will erect a fully equipped plant, valued at an amount to be agreed on, also that the Company performs a certain amount of work during each of the first three years. A heavy bond will be required for the faithful performance of the requirements of the franchise. The revised franchise must also include a clause specifying the candle power of the electric lights and must also give a full description of the system of laying conduits through the city streets and their care. Several other changes were made in the franchise, which was taken to New York last night by Mr. McKeige, who will confer with his Company and will return as soon as possible."

THE average gain in sendout from the Philadelphia works for the first 10 months in 1895, compared with the corresponding period of 1894, amounted to 8.34 per cent.

THE proprietors of the Plattsburgh (N. Y.) Light, Heat and Power Company have just completed an addition of quite some importance to their distributing system.

MUCH complaint has lately been made over the unsatisfactory service rendered by the Palmyra (N. Y.) Gas Light Company. In fact it is said that it is no uncommon thing for the supply to be shut off for 24 hours at a time. This latter condition is quite understandable, viewed in the reading of the following extract from the news of Palmyra as printed in the Rochester *Herald*, of the 2d inst.: "There is much complaint made by business men over the service furnished them by the Palmyra Gas Light Company. For some time, they state, the service has been unsatisfactory, and last night, for some unexplained reason, the gas was shut off entirely, resulting in great inconvenience to merchants, and especially to the Niobe Company, who were playing at the Opera House, which House is lighted entirely by gas. Some of the merchants were obliged to close their stores early as a consequence. One business man, it is said, wanting some lime for use, went to the gas works during the evening for the purpose of getting it, and found the foreman and his assistants in an intoxicated condition. He adds that he came to the conclusion that whiskeyfied workmen could not be depended on to keep up a supply of illuminating gas."

A CORRESPONDENT forwards the following from Stockton, Cal., under date of Nov. 22d: "The Directors of the Stockton Gas and Electric Company recently held a meeting on the grounds of the Company's plant, at the corner of Center street and Hazelton avenue, for the purpose of considering what plans could be formed for the erection of an ice plant in Stockton for making ice for the trade of the entire Valley. If erected the building will occupy the property which the Company owns, just east of the electric plant, and the power will come from the electric plant. No definite conclusion was reached, for the reason that others interested in the proposed plant must be consulted before a plan is finally formulated. Captain Eldridge, one of the Directors, was compelled to go to Sacramento to attend a Directors' meeting there, and Mr. W. J. Dutton, another of the Directors, was compelled to return to San Francisco, Mr. F. A. Hihn, also a Direcror, who resides in Santa Cruz, says that the Company is prepared to go into the proposition and furnish the site and the power, if the other gentlemen, who are more particularly concerned in the matter of ice manufacture, were as ready to proceed as they intimate that they are. 'We have power to spare in the ice making season,' said Mr. Hihn, 'and we are ready and anxious to dispose of it. We also own a suitable site for such a plant, which is adjacent to our power, and furthermore, we are all interested in Stockton and desire to help in all ways to upbuild the city and its manufacturing facilities. The object of our trip was to look over the ground and what were the possibilities. We are satisfied with them and will supply what power we have, and, if necessary, will generate more power. The Company has surplus power in the summer time, and has also a project to use natural gas in gas engines to supplement such power if necessary. The experiment has not been tried as yet, but it will be, and, if successful, the natural gas which we have to spare during the summer can be converted almost directly into power for use in such a plant as is proposed.'"

AN inclosure from Sacramento, Cal., under date of November 23d, says: "There has been considerable curiosity on the part of the public whether or not the Capital Gas Company, now that it has lost the city lighting, and for months past has not supplied power for the electric railways, would dispose of its electric lighting plant, which now lies practically idle, to the Sacramento Electric Light and Power Company. The interests of both Companies would be so subserved by a transfer of the steam plant referred to that the public had every ground for believing that such a transfer would likely come about. As a matter of fact, it seems to have been considered by both parties, and the valuation of the plant, together with the pole system of the city, used for street lighting, practically agreed upon. But it seems that there have been hitches as to terms and conditions, and the action of the Electric Light and Power Company in putting up its own poles would carry the impression that negotiations have fallen through. It is believed that more friendly relations exist between the South Yuba Water Company and the Capital Gas Company than between the latter Company and the Sacramento Electric Light and Power Company. It is known that the Central California Electric Company (under which title the South Yuba Company proposes to bring down its electric currents to Sacramento City) does not desire to enter into the business of retailing electric light and power in this city, and that it prefers to sell in bulk at the city's limit such energy as it brings down, to some local Company that will distribute to the consumers. It is, therefore, not impossible that the Capital Gas Company will again come into the field as a competitor to the Folsom Company by negotiating with the South Yuba Company for the purchase of its electricity, delivered at this city, and utilizing the pole and wire system which it has already."

MR. DAVID L. HOUGH, of this city, is home again, after a protracted journey through Europe. He says that he enjoyed his outing very much, and to discover that it agreed with him in every sense of the word one has but to glance at his well rounded face.

SECRETARY WOODS, of the Gas Engineering Company, of Pittsburgh, Pa., informs us that that Company has been appointed sole agent for this country for the columnless gasholder system, the English proprietor of which is the "Patent Gasholder Syndicate," of Manchester.

AN ordinance has been placed before the City Council, of Argentine, Kas., under which it is proposed to grant to David D. Hoag and others, of Kansas City, Kas., the right to operate a gas works in Argentine. The ordinance calls for a maximum rate of $1 per 1,000 cubic feet, and provides that the Company shall furnish light to the city hall and to the fire department buildings free of charge. Street lamps are to be maintained at the rate of $15 per annum each. Thirty days are given the incorporators in which to accept the franchise, and work on the plant is to be commenced within four months from the acceptance of the grant. Argentine is a city in Wyandotte county, Kas., at a point 4 miles by rail west of the Kansas City line. It is a lively, go-ahead place, and contains extensive manufactories for iron products and furniture. Important smelting works for gold and silver are also located there. Population, about 6,200.

MR. JOSEPH T. BATKINS has been appointed Foreman of the Upper Station of the Richmond (Va.) gas works, vice Mr. B. A. Adams, resigned.

THE following are Sections 1, 2, 3 and 7 of the agreement entered into between the authorities of Montreal and the Montreal Gas Company, for the supply of gas in that city for the next 10 years:

Sec. 1. The said Montreal Gas Company shall furnish all the gas lamps and the gas therefor that the said city of Montreal may require during the existence of the present contract for lighting the streets, lanes and public places of the said city, at the rate of $17 per lamp per year, and at the same conditions as those mentioned in the previous contract between the said city of Montreal and the said Montreal Gas Company passed before me, F. J. Durand, Notary, on the 28th of February, 1884.

Sec. 2. The said Montreal Gas Company do also hereby bind and oblige themselves to supply and furnish gas for lighting, heating, cooking and manufacturing purposes to the public within the limits of the said city of Montreal, during a period of 10 years, to be computed from the 1st day of May last (1895), said gas to be coal gas made from Canadian or bituminous coal, with small proportion of coal oil for illuminating purposes, and of an illuminative power of not less than 21 sperm candles, at a price which shall not exceed $1.20 per each 1,000 cubic feet, generally furnished and supplied by the said Montreal Gas Company, for lighting purposes during the said period of 10 years, and of $1 per each 1,000 cubic feet generally furnished and supplied during the said period by the said Company, for cooking, heating and manufacturing purposes, on prompt payment.

Nevertheless, in order to facilitate the use of gas to the poorer class of people, the said Montreal Gas Company shall be bound to furnish gas for cooking purposes, with the privilege of two gas meters for lighting purposes, at $1.05 per each 1,000 cubic feet furnished and supplied by the said Company by means of automatic regulator burners to all the taxpayers of the said city of Montreal, paying a rent not exceeding $150 a year.

Sec. 3. During the existence of the present contract with the said Montreal Gas Company, the said city of Montreal shall not permit the laying of gas pipes in the streets and lanes of the said city of Montreal.

Sec. 7. The city of Montreal aforesaid shall have the right to provide for the inspection of the gas and meters furnished by the said Company, and to that end to appoint an inspector, who shall also have the power of regulating the pressure of the gas, and shall for that purpose have free access at all times to the works of the said Company.

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MONDAY, DECEMBER 9, 1895.

The Generation and Transmission of Water Power.

At the annual convention of the American Society of Mechanical Engineers, held last week in this city, an interesting paper on the topic named in the heading was read by Mr. Samuel Webber, of Charlestown, N. H.

The author said that the engineers who have been for many years engaged in the question of water supply for large cities have laid it down as an established fact that, by means of proper and complete storage basins, one-half the annual rainfall may be thus saved, the other half being either absorbed by vegetation or dissipated by evaporation.

This amount has been usually estimated for our Northern cities as 1,000,000 gallons per day from each square mile of drainage area, or one-half an annual rainfall of 42 inches, which is a fair average for the larger part of the United States east of Kansas and Nebraska, rising, according to Blodgett, as high as 50 and 55 inches in parts of the Southwestern States, but a safe estimate for the area of drainages from the great Appalachian range, which is as wide an area as we propose to consider in this paper.

It will be readily seen that this annual rainfall of 42 inches amounts to nearly 732,000,000 gallons on a square mile, so that 1,000,000 gallons per day is almost exactly half of it. To secure this half, however, requires the most complete and perfect system of storage basins possible, and it is not safe to calculate on such an amount as being available for water power by any possible and economical means of storage.

It is possible, however, by practicable means of storage, to secure about one-third of the rainfall, and as water for power purposes is usually measured in cubic feet per minute, or per second, instead of gallons, we will now adopt that mode of computation.

An annual rainfall of 42 inches is equal to 267,409 cubic feet per day on a square mile, or 3.09 cubic feet per second, and if we take one-third of this, or 1 cubic foot per second, from each square mile of drainage area, we arrive at the supply which can usually, by the aid of storage, be relied upon.

The paper briefly dwells upon the development of the turbine wheel, and presents the following table as showing the difference in quantity if water used and power obtained by a number of wheels of nearly the same diameter, under the same head of 26 feet, beginning with the Boyden Fourneyron and ending with the Victor:

	Inches Diameter.	Cu. Ft. Water per Second.	Horse Power.
Boyden Fourneyron ..	36	22.95	55.0
Risdon	36	35.45	89.0
Risdon "L. C."	36	48.27	121.0
Risdon "D. C."	36	80.00	199.0
Leffel, Standard	35	40.45	96.0
Leffel, Special	35	60.00	148.0
Tyler	36	40.7	95.8
Swain.....	36	58.2	140.0
Hunt, "Swain bucket"	36	48.8	121.0
Hunt, New Style.....	36	98.0	239.74
Leffel, "Samson"....	35	109.1	264.0
"Hercules".....	36	107.6	253.5
"Victor".....	35	108.8	266.0

This enormous difference in productive effect in wheels of the same diameter shows the great economy of the later type of turbines, particularly as all the wheels above named have a proved efficiency of 80 per cent., and some of them have given more; such as 87 per cent. for the Risdon, tested by Edward Sawyer, of Boston, at Crompton, R. I., and by the writer at the Centennial; 87 per cent. for the Hercules, tested by Prof. Thurston; 84 per cent. for the Collins, by the same authority; 84 per cent. nearly for the Swain, by Mr. Francis; 84 per cent. for the Geyelin and the Hunt, tested by the writer, and 88 per cent. for a 15-inch Victor, by the same, but this was so small a wheel that the test cannot be depended on.

As showing the cost, we take the following in regard to the Concord Water Power Company, on the Merrimac river, at Concord, N.H. Here the power developed is at a minimum 3,300-horse power, on an average 5,000-horse power, from a fall of 22 feet. The wheels are Rodney Hunt turbines, set in pairs on horizontal shafts of 400-horse power each. The cost has been as follows:

700 acres land, and flowage rights....	$ 20,000
Dam and abutments.....	141,015
Canal, 60 feet wide.....	27,363
Head gates.....	16,675
Waste weir.....	5,220
Making an investment for water of...	$210,273

Or $63.72 for the minimum amount of power, or $42.05 for the average amount of power. To this is to be added pits and foundations put in for 2,000-horse power, $15,000, or $7.50 per horse power; wheels put in for 1,600-horse power, $12,225, or $7.66 per horse power, making a total for the minimum flow of water of $78.88 per horse power, and for the average flow of $57.75 per horse power. Now, if we base our calculation of cost on the minimum flow, and allow interest, 5 per cent., sinking fund, 2½ per cent., repairs, 1½ per cent., taxes, etc., 1 per cent., we get a total annual cost of 10 per cent., or $7.89 per horse power, to which add oil and attendance, 75 cents, making $8.64. As this power is to be transmitted, in part, at least, to Concord by electricity, the cost of such transmission, on which I do not assume to be authority, will have to be added to this. If, on the other hand, it is to be partially used near at hand, it is safe to say that the cost of transmission by shafts and belts would not increase it to over $10 per horse power.

A New Coloring for Ironwork.

A suitable medium for coloring iron and steel a dead black, says the London *Iron and Coal Trades Review*, may be produced by mixing together 1 part bismuth chloride, 2 parts mercury bi-chloride, 1 part copper chloride, 6 parts hydrochloric acid, 5 parts alcohol, and 50 parts water. In order to secure the most satisfactory results—the article to be treated being first made clean in every respect, and free from grease—the preparation is applied with a swab or brush, or better still, the object may be dipped into it, the liquid being allowed to dry on the metal, and the latter then placed in boiling water and the temperature maintained for half an hour. If after this the color is not so dark as may be desired for the purpose, the operation is simply repeated, the required density being thus easily attained, and after obtaining the desired degree of color the latter is fixed as well as improved generally by placing for a few moments in a bath of boiling oil and heating the object until the oil is completely driven off.

Alumina from Clay.

An important contribution appears in *Comptes Rendus*, by Heibling, indicating the production of alumina from clay, so as to be absolutely free from silica and readily convertible into sulphate, etc. To this end the clay is thoroughly incorporated with a mixture, in equal parts, of ammonia and potassium sulphates, in such proportion that three molecules of ammonium sulphate may be present to every molecule of alumina, and the mixture is made into hollow bricks, which are then heated in an oven at 270° to 280° C. At this temperature both gaseous ammonia and acid ammonium sulphate are given off, which immediately reacts with the potash salt present, acid potassium sulphate being formed—the latter, at the above temperature, combining with the alumina of the clay to form alum. The alum is finally extracted from the bricks by means of water and freed from iron by recrystallization, and the insoluble silica remaining behind may be employed in cements. Granular alumina is prepared by spreading out the powdered alum in a thin layer on shelves arranged in a vertical tower, which is traversed by the warm, moist, ammoniacal fumes derived from the brick oven. Thus the alum is transformed *in situ* into alumina, retaining the form of the original powder, and potassium and ammonium sulphates.—*Sci. Am.*

The Market for Gas Securities.

A notable feature in the market for city gas shares is the long jump made in Mutual, the bid price to-day (Friday) being 225. Equitable is strong at 205. Consolidated 147 to 148.

The event of the week, as affecting gas investment affairs, is, of course, the decision handed down by Judge Showalter in the injunction proceedings instituted by Pitt Barrows, in which combination by the Chicago Companies was sought to be prevented. The Judge denies the restraining order asked for, and announces the right of the Companies constituting the Trust to combine "where and when they please." As a result, Chicago shares are to-day quoted at 69¾.

Gas Stocks.

Quotations by Cochran & Close, Brokers and Dealers in Gas Stocks.

35 Wall St., New York City.

December 9.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$35,430,000	100	147	148
Central	500,000	50	150	..
" Scrip	220,000	..	100	.
Equitable	4,000,000	100	205	..
Bonds, 6's	1,000,000	1,000	106	..
" 1st Con. 5's	2,300,000	1,000	114	.
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	225	..
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	..	..	.
Northern	150,000	50	79	80½
" Bonds	150,000	1,000	..	98
New York and East River	5,000,000	100	32¾	33½
Preferred	2,000,000	100	63½	65
Bonds 1st 5's	3,500,000	1,000	101	102½
" 1st Con. 5's	1,500,000	..	83	84
Richmond Co., S. I.	348,650	50	50	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	70½	72
Preferred	5,000,000	100	106½	108
Bonds, 1st Mortgage, 5's	1,500,000	1,000	110	113
Yonkers	200,000	50	112	..
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	140	..
Citizens	1,200,000	20	70	..
" S. F. Bonds	320,000	1,000	..	101
Equity	2,000,000	10	..	..
" Bonds	1,000,000	..	..	..
Fulton-Municipal	3,000,000	100	220	..
" Bonds	300,000	..	108	..
Peoples	1,000,000	10	100	.
" Bonds, 7's	368,000	..	100	..
" " 6's	94,000	..	98	100
Metropolitan	870,000	100	200	..
" Bonds, 5's	70,000	..	..	..
Nassau	1,000,000	25	310	..
" Ctfs	700,000	1,000	99	100
Williamsburgh	1,000,000	50	310	..
" Bonds	1,000,000	..	107	110
Out-of-Town Companies.				
Bay State	5,000,000	50	20	22
" Income Bonds	2,000,000	1,000	..	30
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	78	80
2d " " "	3,000,000	1,000	54	56
Buffalo Mutual	750,000	100	125	..
" Bonds	200,000	1,000	95	100
Central, San Francisco	2,000,000	..	95	..
Chicago Gas Co.	25,000,000	100	69	69¼
Chicago Gas Lt. & Coke Co. Guaranteed Gold Bonds	7,650,000	1,000	94	94¼
Columbus	1,069,000	..	66½	67
1st Mortgage	1,065,000	..	94	95
Consumers. Jersey City	2,000,000	100	85	90
" Bonds	600,000	1,000	100	102
Cincinnati G. & C. Co.	7,000,000	100	204	204¼
Consumers, Toronto	1,800,000	50	184½	187
Capital, Sacramento	500,000	50	..	41
Bonds (6's)	150,000	..	..	..
Consolidated, Baltimore	11,000,000	100	59	60
Mortgage, 6's	3,600,000	..	107	107½
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490,000	..	..	..
Detroit	4,000,000	..	29½	30¼
" Con. Bonds	4,312,000	..	..	70
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Fort Wayne	2,000,000	..	76½	78½
" Bonds	2,000,000	..	89	91
Hartford	750,000	25	130	135
Indianapolis	2,000,000	..	142	147
" Bonds, 6's	2,650,000	..	103	105
Jersey City	750,000	20	180	..
Lafayette Gas Co., Ind.	1,000,000	100	83	85
Bonds	1,000,000	1,000	85	87
Louisville	2,570,000	50	..	130
Laclede, St. Louis	7,500,000	100	24	26
Preferred	2,500,000	100	83	84
Bonds	9,034,400	1,000	96½	97
Little Falls, N. Y.	50,000	100	..	100
Bonds	25,000	..	..	100
Montreal, Canada	2,000,000	100	200	..
Newark, N. J., Gas Co.	1,000,000	..	75	.
Bonds, 6's	4,000,000	..	120	..
New Haven	1,000,000	25	225	..

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United Gas Improvement Co., Phila., Pa.	953
Burdett Loomis, Hartford, Conn.	962
National Gas and Water Co., Chicago, Ills.	955
Economical Gas Apparatus Construct'n Co., Toronto, Ont	961
The Western Gas Construction Co., Fort Wayne, Ind.	954

GAS WORKS APPARATUS AND CONSTRUCTION.

James R. Floyd & Sons, New York City	964
Continental Iron Works, Brooklyn, N. Y.	962
Deily & Fowler, Phila., Pa.	964
Kerr Murray Mfg. Co., Fort Wayne, Ind.	960
Stacey Mfg. Co., Cincinnati, Ohio	963
Bartlett, Hayward & Co., Baltimore, Md.	961
Davis and Farnum Mfg. Co., Waltham, Mass.	960
R. D. Wood & Co., Phila., Pa.	962
Isbell-Porter Company, New York City	962
Fred. Bredel, Milwaukee, Wis.	959
United Gas Improvement Co., Phila., Pa.	953
Berlin Iron Bridge Co., East Berlin, Conn.	960
National Gas and Water Co., Chicago, Ills.	955
Economical Gas Apparatus Construct'n Co., Toronto, Ont.	961
The Western Gas Construction Co., Fort Wayne, Ind.	954
Humphreys & Glasgow, New York City	950
Gas Engineering Co., Pittsburgh, Pa.	960

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Gas Engineering Co., Pittsburgh, Pa.	960

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Fred. Bredel, Milwaukee, Wis.	959
J. H. Gautier & Co., Jersey City, N. J.	959
Parker-Russell Mining and Mfg. Co., St. Louis, Mo.	958
Adam Weber, New York City	958

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Michigan Ammonia Works, Detroit, Mich.	944
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Gas Engineering Co., Pittsburgh, Pa.	960

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The Goodwin Meter Co., Phila., Pa.	966
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D. McDonald & Co., Albany, N. Y.	967
Nathaniel Tufts, Boston, Mass.	966
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Metric Metal Co., Erie, Pa.	965
Keystone Meter Co., Royersford, Pa.	966
The Hillen Meter Co., Brooklyn, N. Y.	967

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M. J. Drummond, New York City	965
R. D. Wood & Co., Phila., Pa.	962
Warren Foundry and Machine Co., New York City	965
Donaldson Iron Co., Emaus, Pa.	965
Addyston Pipe and Steel Co., Cincinnati, O.	964

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Peerless Rubber Mfg. Co., New York City	945

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H. E. Parson, New York City	959

GAS COALS.

Penn Gas Coal Co., Phila., Pa.	957
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Despard Gas Coal Co., Baltimore, Md.	957
Westmoreland Coal Co., Phila., Pa.	957
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Berwind-White Coal Mining Co., New York and Phila.	956
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Standard Oil Co., New York City	957
The Sun Oil Co., Pittsburgh, Pa.	957

COKE CRUSHER.

C. M. Keller, Columbus, Ind.	957

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C. W. Hunt Company, N. Y. City	945

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The Bristol Co., Waterbury, Conn.	945

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City.	955
Isbell-Porter Co., New York City	962

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B. Kreischer & Sons, New York City	958
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Laclede Firebrick Mfg. Co., St. Louis, Mo.	958
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James Gardner, Jr., Pittsburgh, Pa.	953
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Baltimore Retort and Firebrick Co., Baltimore, Md.	958
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Brooklyn Firebrick Works, Brooklyn, N. Y.	958
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C. L. Gerould & Co., Mount Vernon, N. Y.	958
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INCANDESCENT GAS LAMPS.

Welsbach Light Co., Gloucester, N. J.	947

MICA GOODS.

The Mica Mfg. Co., New York City	945

BURNERS.

C. A. Gefrorer, Phila., Pa.	962
George Bray & Co., Leeds, England	943
Theo. Clough, Dobbs Ferry, N. Y.	944

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn.	945

GAS TUBING.

New York Gas Tubing Co., New York City	945

STREET LAMPS.

Bartlett Lamp Mfg. Co., New York City	959

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City	955
Greenpoint Chemical Works, Brooklyn, N. Y.	955
Henry W. Douglas, Ann Arbor, Mich.	955

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind.	952
Isbell-Porter Company, New York City	962
Connelly Iron Sponge and Governor Co., New York City	955

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y.	954
Chapman Valve Manufacturing Co., Boston, Mass.	954
R. D. Wood & Co., Phila., Pa.	962
Continental Iron Works, Brooklyn, N. Y.	962
The P. H. & F. M. Roots Co., Connersville, Ind.	952
Isbell-Porter Co., New York City	962
The Western Gas Construction Co., Fort Wayne, Ind.	954

ELECTRICAL APPARATUS.

Wm. Henry White, New York City	963

GAS ENGINES.

Otto Gas Engine Works, Phila., Pa.	968
The American Gas Engine Co., Phila., Pa.	946

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City	964
W. G. & G. Greenfield, East Newark, N. J.	964

PURIFIER SCREENS.

John Cabot, New York City	945

GAS STOVES.

American Meter Co., New York and Philadelphia..... 951
The Goodwin Meter Co., Phila., Pa..... 966
George M. Clark & Co., Chicago, Ills..... 949
Maryland Meter and Manufacturing Co., Baltimore, Md.. 966
William M. Crane & Co., New York City..... 949
Keystone Meter Co., Royersford, Pa..... 966
A. Weiskittel & Son, Baltimore, Md..... 584
The Wolff Gas Radiator Mfg. Co., New York City..... 947
Wilder Mfg. Co., Phila., Pa..... 945

CHINA GAS KILNS.

William M. Crane & Co., New York City..... 949

COIN WRAPPERS.

Alvord & Co., Detroit, Mich..... 905

GASHOLDER PAINT.

New York Marine Paint Co., Poughkeepsie, N.Y..... 954

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Williams Mfg. Co., Kalamazoo, Mich..... 944

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y..... 954

GASHOLDERS.

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Deily & Fowler, Philadelphia, Pa..... 964
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Kerr Murray Mfg. Co., Fort Wayne, Ind..... 960
Stacey Mfg. Co., Cincinnati, Ohio..... 963
R. D. Wood & Co., Philadelphia, Pa..... 962

PATENTS.

H. B. Willson & Co., Washington, D. C..... 957

DIVIDEND NOTICE.

OFFICE OF WELSBACH COMMERCIAL COMPANY,
40 WALL ST., NEW YORK CITY, Nov. 14, 1895.

The Directors have this day declared a quarterly dividend of two (2) per cent on the preferred stock, payable on Dec. 10, 1895, to stockholders of record at the close of business Nov. 30. Transfer books will be closed from Dec. 1 to 10, both inclusive. Checks will be mailed.

1068-3 EDWARD C. LEE, Treasurer.

POSITION WANTED

As Supt. or Manager of a Gas Works or Gas and Electric Light Works.

Fifteen years' experience as Manager of Gas Works and six years Gas and Electric Light Works. Good reasons for wishing to change present employment.

1043-tf Address "Y. B.," care this Journal.

WANTED,

A Second-Hand Gas Engine of Some Standard Make,

that will develop from 8 to 10 horse power. Address, giving price and full particulars,

CAPITAL GAS AND ELECTRIC LT. CO.,
1065-6 Frankfort, Ky.

WANTED,

By a man who has had a round experience in the manufacture and sale of gas,

A Position as Supt. of a Large or Smal' Gas Works.

Is capable and energetic, and is willing to begin at a moderate salary. Address

1032-tf "B.," care this Journal.

GAS WORKS.

WANTED TO PURCHASE, whole or controlling interest in small Gas Company not having electric light attachment. Must be in New England, New York, New Jersey or Pennsylvania. Give particulars as to indebtedness outside of capital stock, selling price, population and kind of gas made. All communications will be treated as confidential. Address "INVESTMENT," care this Journal.

SITUATION WANTED

By Mechanical Draughtsman with Technical Education.

Experienced in constructing gas apparatus, valves, specials, and general machinery. Address

1070-1 "E.," care this Journal.

Coal Tar For Sale.

CONSUMERS GAS COMPANY,
TORONTO, CANADA, Nov. 27, 1895.

Tenders will be received until noon on Friday, Dec. 13, for the Coal Tar produced at this Company's works, on a basis of one, three, or five years, at a price per barrel of 35 imperial gallons (equal to 42 American gallons). Particulars as to quantities, facilities, terms of payment, etc., may be obtained on application to the undersigned, to whom tenders may be addressed. No tender necessarily accepted.

WILLIAM H. PEARSON,
1069-2 General Manager & Secretary.

Proposals for Coal Tar.

The North Adams (Mass.) Gas Light Company invites Proposals for its annual output of Gas Tar, amounting to 600 barrels. The gas made on these works is strictly produced from the carbonization of the best gas coal, no oil being used even for enriching purposes.

1064-tf F. S. RICHARDSON, Treasurer.

FOR SALE,

One No. 7 Gas Exhauster, Wilbraham-Baker Blower Company's Make.

Capacity, about 70,000 ft. per hour. The Exhauster is complete, with Governor and Engine all on bedplate; is in good condition (almost as good as new); was not used much; replaced by a larger machine of same make. Apply to the undersigned, care of Pittsburgh Gas Co., 435 Sixth Avenue, Pittsburgh, Pa.

JOHN H. McELROY,
1070-8 Engineer.

FOR SALE,

Harris & Griffin Station Meter.

From the fact that we have to buy a much larger meter, we now offer for sale, at a bargain, a 48x48 inch Harris & Griffin Station Meter, now in use at our works.

CHAMPAIGN & URBANA GAS LT. & COKE CO.,
1,068-3 Champaign, Ills.

FOR SALE,

Four Purifying Boxes, 8 ft. by 8 ft.,

with 6-inch Center Valves and Connections, in good order.

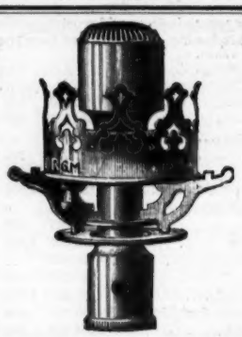
HOUSTON GAS LIGHT CO.,
1064-8 Houston, Texas.

FOR SALE,

Gas and Electric Plant in Substantial, Growing Kansas Town of 5,000 People.

No bonds nor debts outstanding. It is a money maker. Present owners wish to retire from business. Will sell whole or half interest. $10,000 will secure half interest and the superintendency, at $75 per month. Address

1068-4 RODOLPH HATFIELD, Wichita, Kas.



GAS INCANDESCENT LIGHT BURNERS AND INCANDESCENT MANTLES.

Manufactured in only the Highest Grades marketable.

MARTIN GÜLZOW, 26 Suydelstrasse **Berlin, C.**

WANTED,

A General Agent for Fixed Sales.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to

STROH & OSIUS, Pat'ees, Cr
Mich. Ammonia Works, Detroit, Mich.

Patent Lava Gas Tips.

UNIFORMITY GUARANTEED.

ALL SIZES AND SHAPES.

D. M. STEWARD MFG. CO.,
CHATTANOOGA, TENN.

Gas Incandescent Light.

NO INFRINGEMENT OF THE AUER PATENTS TO BE SUBSTANTIATED.

Ia. Ia. Transportable Solid Incandescent Bodies..... 30 cents.
Ia. Burners with Steatite (very Economical)..... 30 "
id. without id. ..... 20 "

Only the very best qualities offered for cash by

GASGLÜHLICHTFABRIK. MARTIN GÜLZOW, Berlin C., Germany.

Red Cedar TANKS.

Cylinders and Caissons of PINE or CYPRESS. Any size.
WILLIAMS MFG. CO., Kalamazoo, Mich.

16 Murray St., New York.
737 Monadnock Bldg., Chicago.
36 S. Market St., Boston.
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THEO. CLOUGH,

MANUFACTURER OF

Clough's Patent Adjustable Gas Burners, Maxim Burners for Gasoline Gas Machines, Natural Gas Burners.

E. H. Nickel Tips for Water Gas.

Iron Burners of Every Description. Prices and Catalogue on Application,

THEO. CLOUGH, - - - - - Dobbs Ferry, N. Y.

Get Our Prices on

Mica Chimeys

For Welsbach Lights,

AND ON

Mica Canopies.

The MICA MFG. CO.,

Micasmiths,

88 Fulton Street, - - New York City.

F. BEHREND,

SOLE IMPORTER OF THE CELEBRATED

German (Stettin-Didier) Clay Gas Retorts,

BLOCKS, TILES, FIREBRICKS, FIRE CEMENT,

Stettin "Anchor" & "Eagle" Brand Portland Cement

10 & 12 Old Slip, New York.

G. W. HUNT COMPANY.

THE HUNT TIP CAR.

45 BROADWAY,

COKE CARS for Gas Works,
TIP CARS for Carrying Ashes,
CHARGING CARS for Bringing Coal from the Storage Bins to Boiler Room and Retort Houses.

INDUSTRIAL RAILWAYS

Specially designed for handling material in and around

Gas Works, Coal Yards, Factories, Etc., Etc.

- - NEW YORK.

If You Want the Best GAS-TIGHT Tubing,

BUY OF THE

NEW YORK GAS TUBING CO.

771-779 Greenwich St., N. Y.

GUARANTEED NOT TO STIFFEN. Makers of All Kinds of Flexible Tubing.

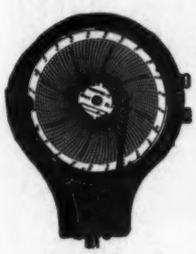
The Celebrated **SHANER GAS COAL**

CORRESPONDENCE SOLICITED.

Is Mined and Shipped from the Best Gas Coal Basin in Pennsylvania.

SHANER COAL CO., - 1326 Chestnut Street, Philadelphia.

BRISTOL'S RECORDING **PRESSURE GAUGE**



For Continuous Records of

Street Gas Pressure.

Simple in Construction,
Accurate in Operation,
Low in Price,
Fully Guaranteed.

Send for Circulars.

THE BRISTOL CO.

Waterbury, Conn.

Received Medal at World's Columbian Exposition.

Special Trays for Iron Sponge or Oxide of Iron.

CHURCH'S TRAYS a Specialty.

Reversible, Strongest, Most Durable, Most Easily Repaired

306-310 Eleventh Avenue, New York.

We also make the Cheapest and Strongest REVERSIBLE BOLTED TRAYS IN THE MARKET

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TRIUMPH REGENERATIVE GAS HEATER

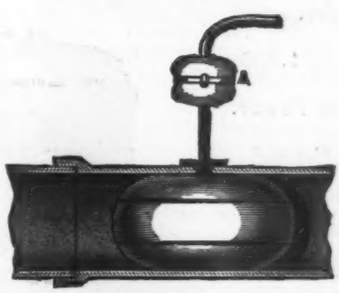
Wilder's Patents, Nov. 15 & 22, 1892.

Heats both air and gas before combustion. Gives high flame temperature and maximum economy, with entire freedom from smoke and smell. Radiates heat to the floor. Warms the feet and does not overheat the head. No headache and no colds caused by cold feet where this Heater is used. Has Group Governor, which regulates gas volumetrically proportionate to heat desired; the only correct regulation for stoves and furnaces. A gas heater, if a free gift, is still costly and extravagant if it burns gas wastefully. The Triumph Heater is constructed upon correct principles, and gives results not obtained with any other.

Write for descriptive circulars and order sample Heater.

WILDER MFG. CO., 816-822 Cherry St. Phila.

Peerless Patent Improved Gas Bag



These Gas Bags are used to stop the flow of gas while repairing or making alterations in gas mains. There have been numerous cases of workmen being badly injured, and sometimes fatally, by the escape of gas resulting from the bursting of a bag, and our patent improvement is designed to obviate such calamities. The indicator *A* shows unerringly when the bag has been sufficienty inflated to pack the main, and when the pumping should be stopped. Our Bags are made of a rubber stock especially prepared to admit of great distension, and to resist the action of Oils, Gases, Naphtha and other residuum in the mains, and they are made with lapped joints, which adds greatly to their strength.

3-in.	Gas Bag,	each,	$0.60	12-in.	Gas Bag,	each,	$5.00
4	"	"	.80	16	"	"	8.25
5	"	"	1.05	20	"	"	12.00
6	"	"	1.75	24	"	"	17.00
8	"	"	2.65	30	"	"	27.50
10	"	"	3.75				

The Peerless Rubber Mfg. Co.

16 Warren St., N. Y. City.

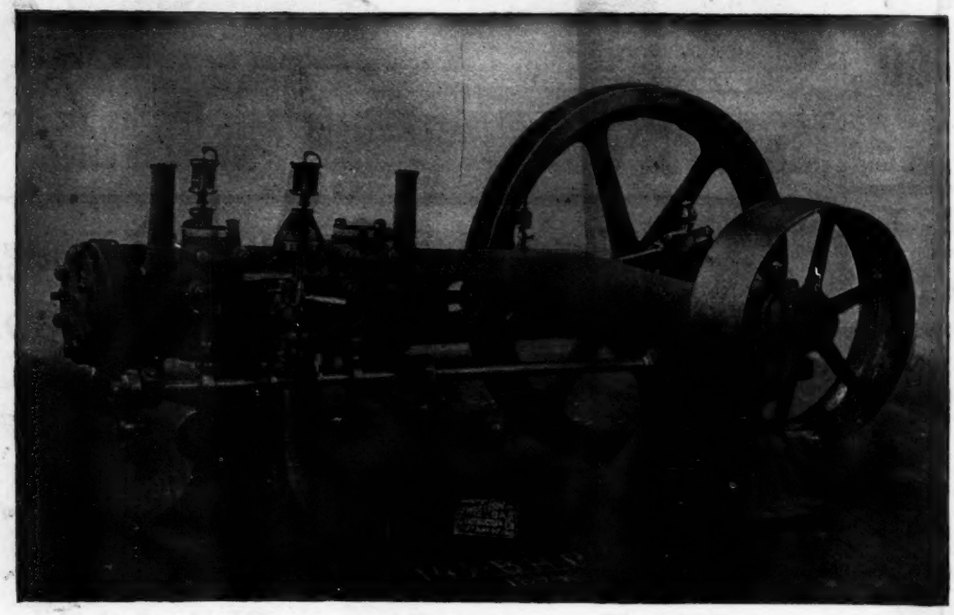
WM. W. GOODWIN, Prest. O. N. GULDLIN, V.-Prest. & Treas. H. B. GOODWIN, Sec. ERNEST F. LLOYD, Asst. Sec

THE AMERICAN GAS ENGINE CO.,

MANUFACTURERS OF

The Double-Acting Gas Engine,

Under the Patents of Griffin, and Dick, Kerr & Co., of London and Kilmarnock.



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Single Cylinder.

Impulse Every Revolution.

(Two Strokes.)

15 to 500 Horse Power.

For General Work and Isolated Electric Plants.

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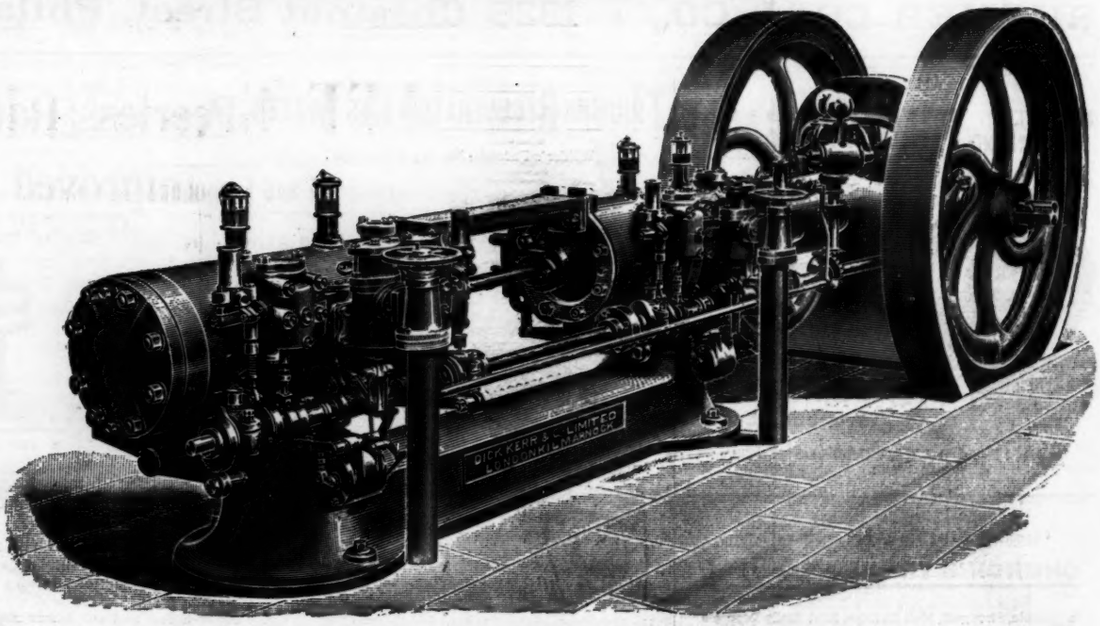
Tandem Cylinder.

Impulse Every Stroke.

100 to 1,000 Horse Power.

For Central Stations and all work requiring extreme steadiness.



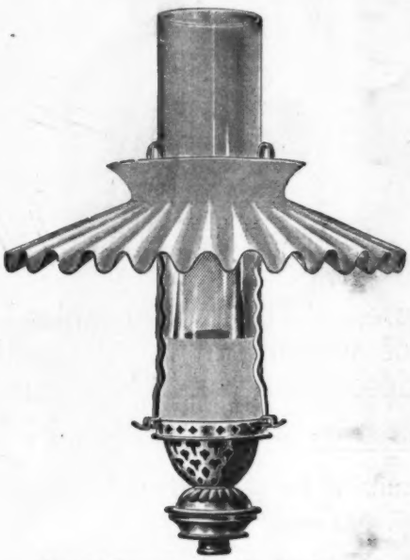
ESSENTIAL PRINCIPLE.—An impulse at each end of piston; using half force to each impulse; doubling the steadiness; reducing the wear on moving parts, and weight for given power. **CONSTRUCTION.**—The piston rod works through stuffing box in front end of cylinder, and connecting rod is carried in a cross-head working in a slide in frame, as in ordinary steam engine practice. All valves are of the poppet type, operated by cams on a single cam-shaft, giving positive movement to every working part. Tube or electric ignition. **RESULT.**—An engine of extreme simplicity and steadiness of action, the even wear on the cylinder and all working parts assuring increased economy, long life, and minimum cost in repairs. **RECORD.**—Successful and constant use in Great Britain for the past eight years. Address

W. W. GOODWIN, President, Lock Box 718, Philadelphia, Pa., or
THE WESTERN GAS CONSTRUCTION CO. Bldrs. & Gen. Agts., Fort Wayne Ind.

The Improved

Welsbach Light.

No. 31 Burner, with Nos. 10 and 43 Shades.



No. 31 Burner, with No. 74 Shade.

Made by the

Welsbach Light Company,

Gloucester City, N. J.

Sole Manufacturers for the United States.

The WOLFF Gas Radiator.

Size, 33 Inches High, 21 Inches Wide and 10 Inches Deep. The Trilby Heaters are furnished in Brass, Copper-Bronze and Nickel Plate.

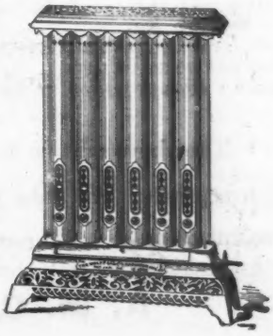
The Most Ornamental and Economical Gas Heater in the World.

The WOLFF Gas Radiators are no Longer an Experiment.

Heating with gas as a fuel instead of wood or coal was made practicable only four years ago, when the first WOLFF Gas Radiator was made. Since that time we have supplied Gas Radiators to heat all kinds of Rooms, Halls, Stores, Churches, Theaters, etc.; they are used in Bed Chambers, Sick Rooms, and wherever heat is required. And, because of their great success, several imitation Gas Radiators are offered, "said to be as good as Wolff's;" but none of them are as good. The WOLFF Radiator gives more and better quality of heat, at less cost, than any gas heater in the market.

In our Trilby Heater we again offer something **new, novel** and **good,** as well as beautiful and pleasing to the eye. Most Stoves, Heaters and Radiators in use heat the **top** of the room, leaving the **floor** cold (hence keep the head warm and the feet cold). Our Trilby Heater warms the floor first; then the heat rises gradually, warming the whole room comfortably, cold air being drawn in from the bottom (passing between the heated radiating flues) and thoroughly warmed before passing out at the top, while the gas, mixed with air, is burned in our "Patent Incandescent Iron Fires Burners," which greatly intensifies the heat, causing an extra amount of heat to be radiated, or thrown off onto the floor, while the products of combustion are carried up through radiating iron flues to the top of the Trilby Heater, and downwards and out through opening to flue or chimney pipe connection, making a current or outlet for burnt gas or impure air, thus causing perfect ventilation in the room.

The Trilby uses less gas and gives more and better heat than any other Gas Radiator in the market.



MANUFACTURED BY

THE WOLFF GAS RADIATOR MANUFACTURING CO.,

Office, 164 Franklin St., New York.

Bray's Patent "Enamel" Gas Burners.

Bray's "Special" and "Adjustable" Burners

Are the Cheapest, Most Economical and Most Durable in existence, and will, at their REDUCED PRICE, save their cost in gas alone in forty hours' use.

Union Jet. Slit Union. Batswing. Adjustable.

The "Specials" are made to Suit Low and High Pressures. The "Adjustables" consist of two Burners screwed together, the sizes of which can be arranged to suit any Pressure and Consumption. For full description see Catalogue.

See that **"Bray's Special"** or **"Bray's Adjustable"** is stamped on each kind of Burner.

ACETYLENE AND RICH OIL GASES.—We now make Burners suitable for use with these Gases.

TO BE HAD OF DEALERS THROUGHOUT THE STATES.

IN NEW YORK: E. P. Gleason Mfg. Co., 181 to 189 Mercer St. Consolidated Gas Co. of New York, 4 Irving Place.

IN BOSTON, MASS.: Waldo Brothers, 88 Water Street.

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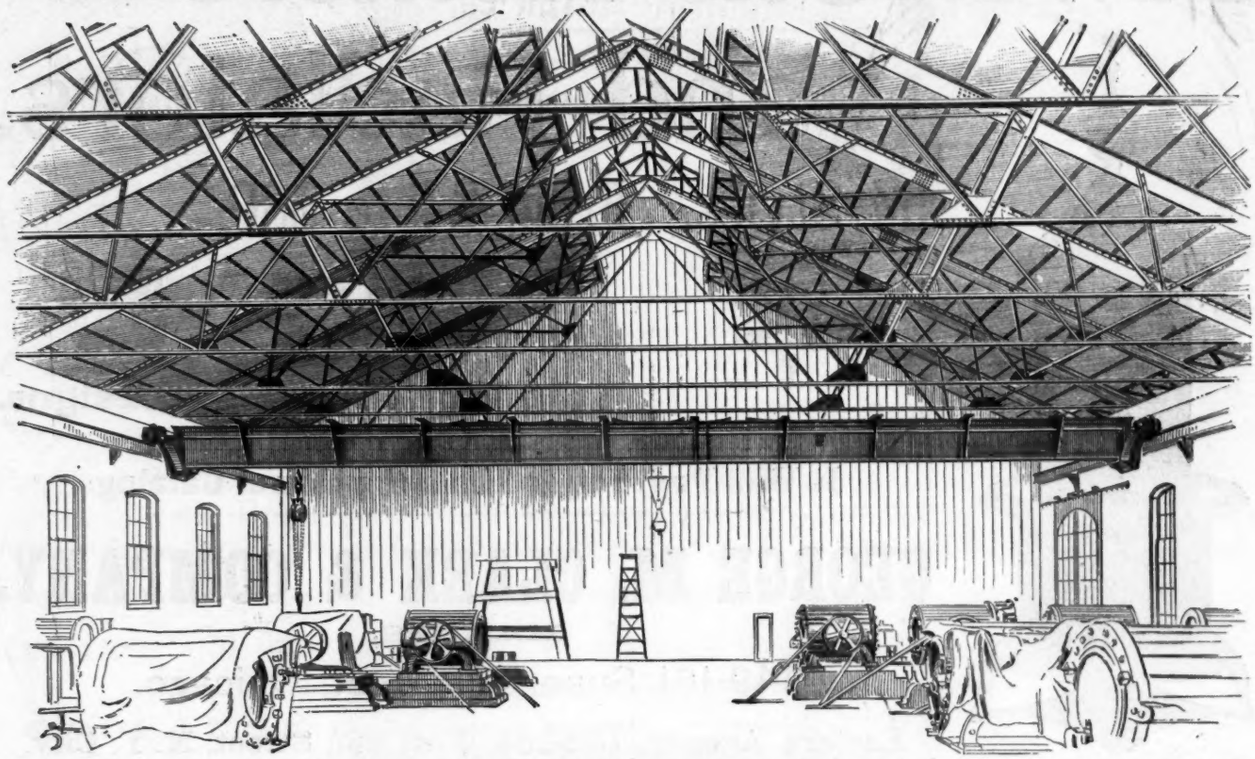

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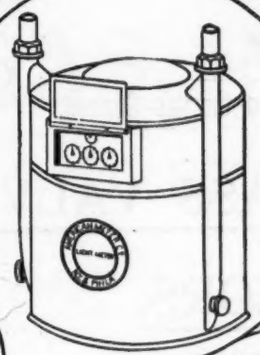

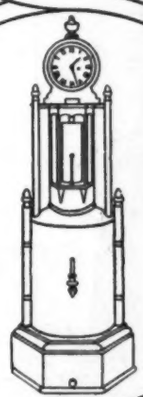

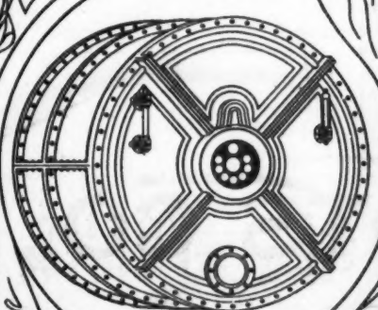

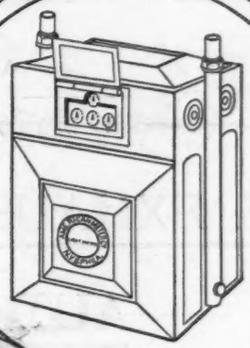

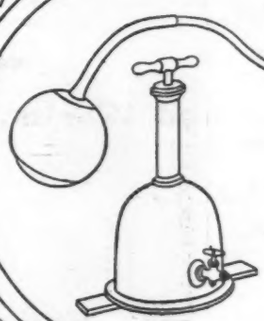

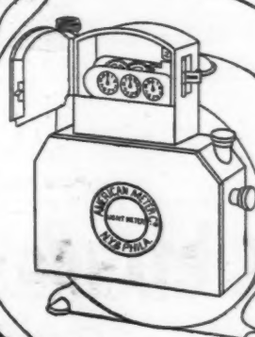

PUBLIC LIGHTING TABLE.

DECEMBER, 1895.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sun.	1	No L. FM	No L.	4.20	6.10
Mon.	2	No L.	No L.	4.20	6.10
Tue.	3	5 00 PM	6.30 PM	4.20	6.15
Wed.	4	5.00	7.40	4.20	6.15
Thu.	5	5.00	8.50	4.20	6.15
Fri.	6	5.00	10 10	4.20	6.15
Sat.	7	5.00	11.20	4.20	6.15
Sun.	8	5.00 LQ	12.40 AM	4.20	6.15
Mon.	9	5.00	1.50	4.20	6.15
Tue.	10	5.00	3.00	4.20	6.20
Wed.	11	5.00	4.10	4.20	6.20
Thu.	12	5.00	6.10	4.20	6.20
Fri.	13	5.00	6.10	4.20	6.20
Sat.	14	5.00	6.10	4.20	6.20
Sun.	15	5.10 NM	6.20	4.20	6.20
Mon.	16	5.10	6.20	4.20	6.20
Tue.	17	5.10	6.20	4.20	6.20
Wed.	18	5.10	6.20	4.20	6.20
Thu.	19	5.10	6.20	4.20	6.20
Fri.	20	8.00	6.20	4.20	6.20
Sat.	21	9.00	6.20	4.20	6.20
Sun.	22	10.00	6.20	4.20	6.20
Mon.	23	11.00 FQ	6.20	4.20	6.20
Tue.	24	12.00 AM	6.20	4.20	6.25
Wed.	25	1.00	6.20	4.20	6.25
Thu.	26	2.10	6.20	4.20	6.25
Fri.	27	3.20	6.20	4.20	6.25
Sat.	28	4.20	6.20	4.20	6.25
Sun.	29	5.30	6.20	4.20	6.25
Mon.	30	No L.	No L.	4.20	6.25
Tue.	31	No L. FM	No L.	4.20	6.25

TOTAL HOURS LIGHTING DURING 1895.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	237.00	January	423.20
February	196.40	February	355.25
March	195.50	March	355.35
April	165.30	April	298.50
May	153.40	May	264.50
June	138.20	June	234.25
July	146 30	July	243.45
August	152.50	August	280.25
September	165.10	September	321.15
October	186.10	October	374.30
November	204.10	November	401.40
December	219.30	December	433.45
Total, yr	2161.20	Total, yr	3987.45

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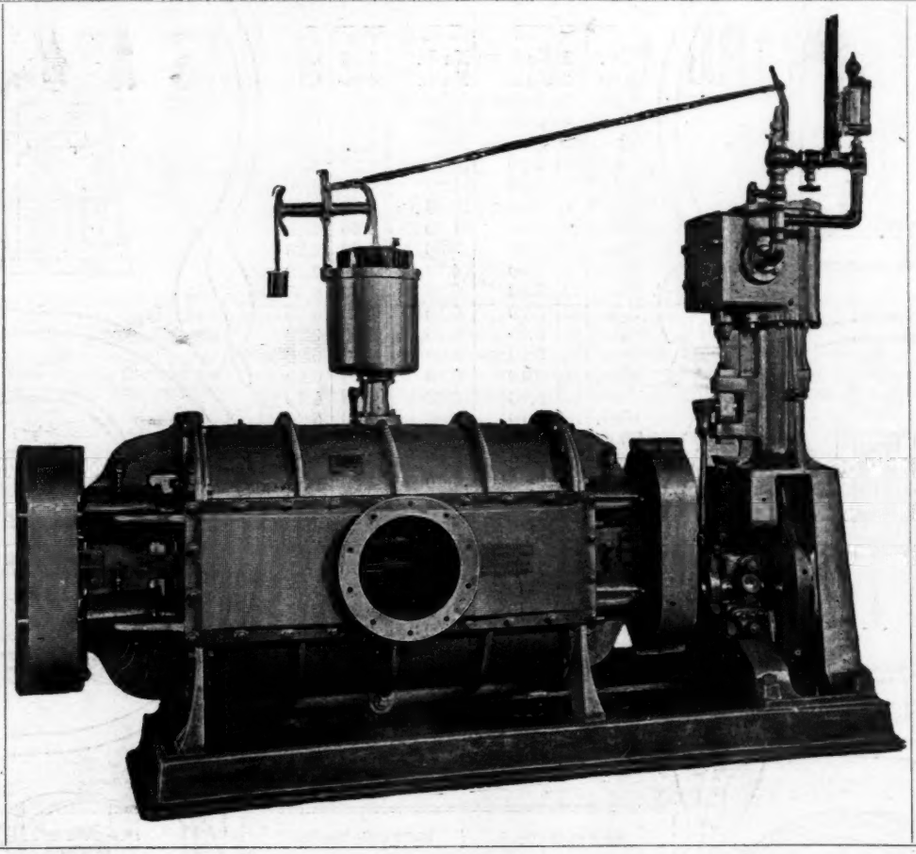

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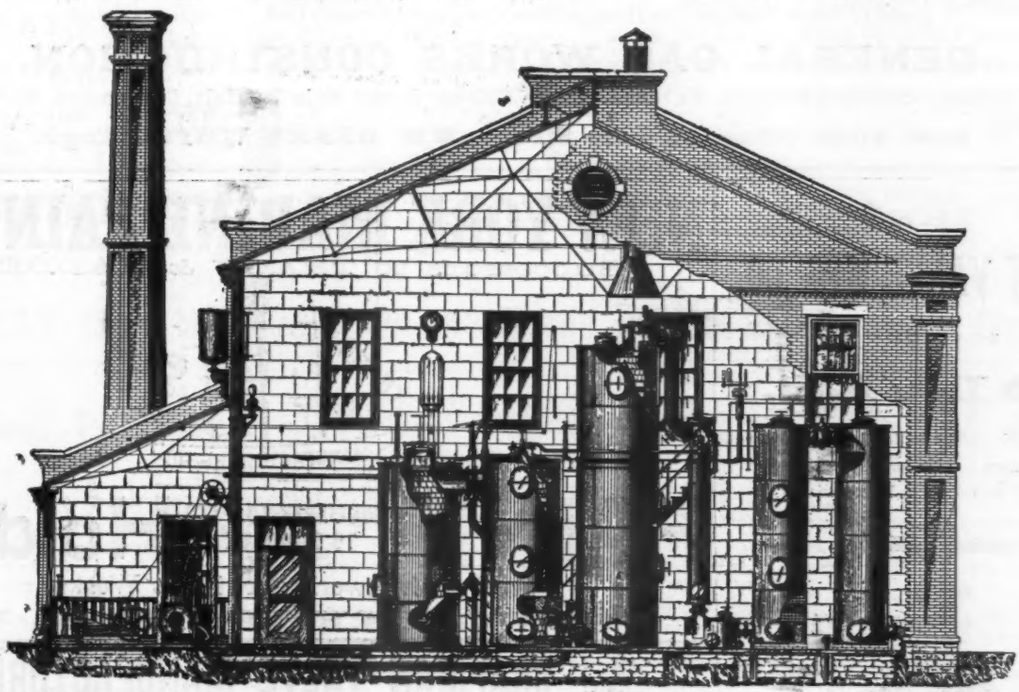

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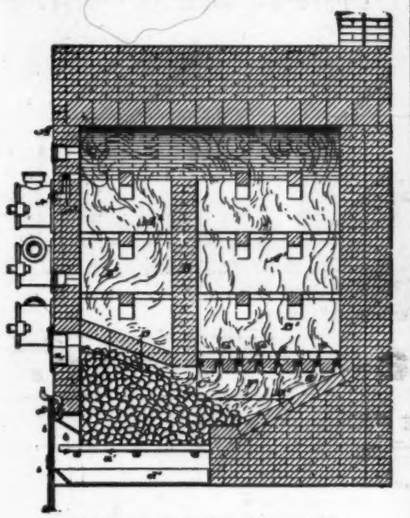

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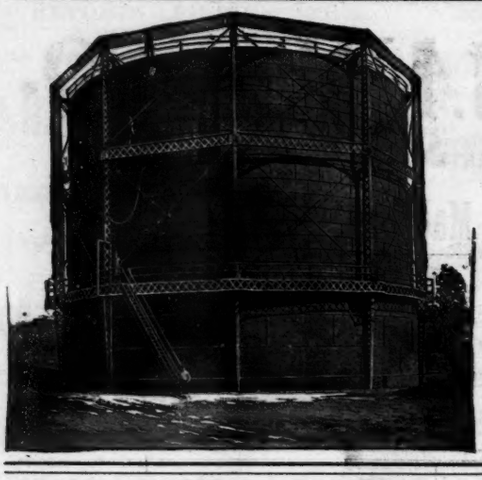

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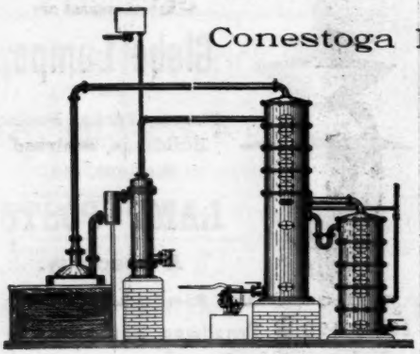

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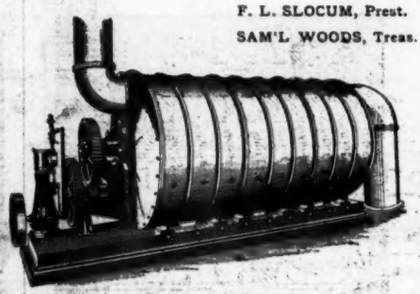

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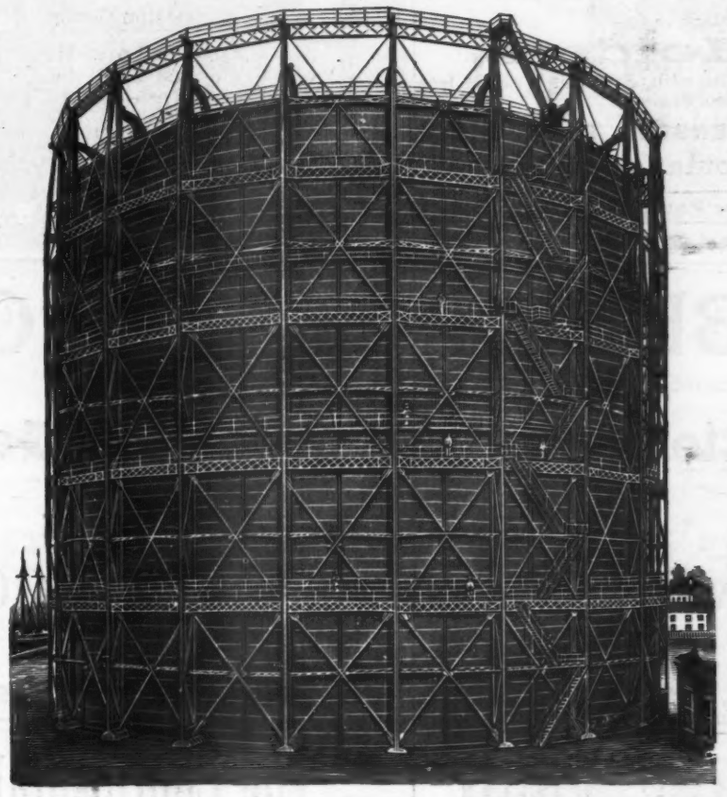

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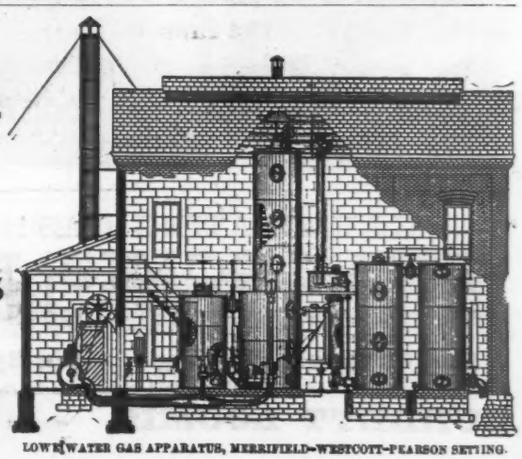

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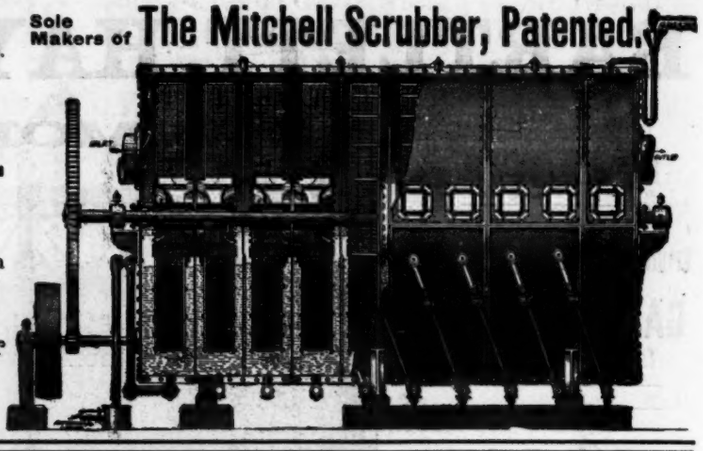

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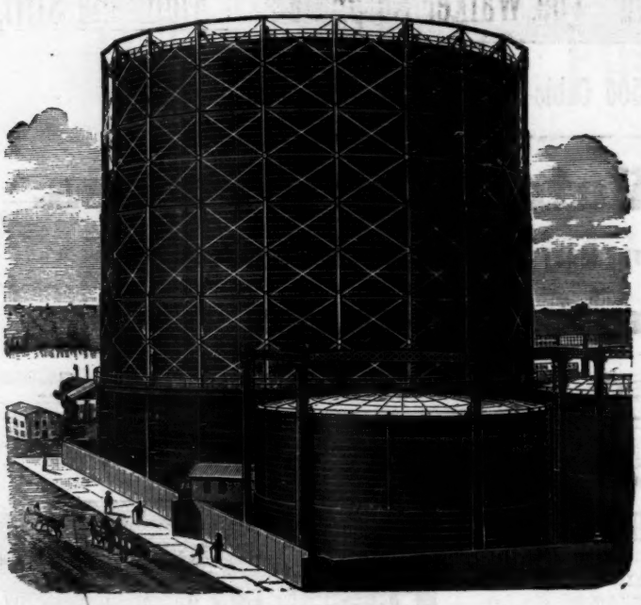

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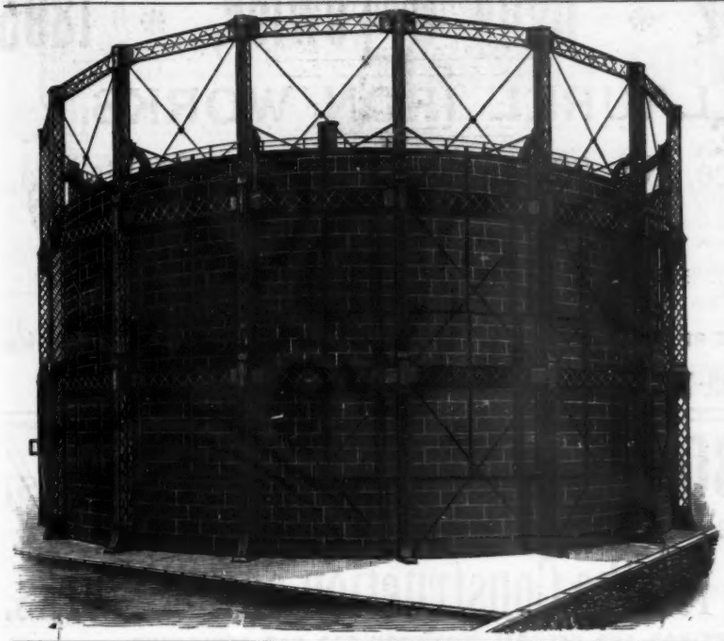

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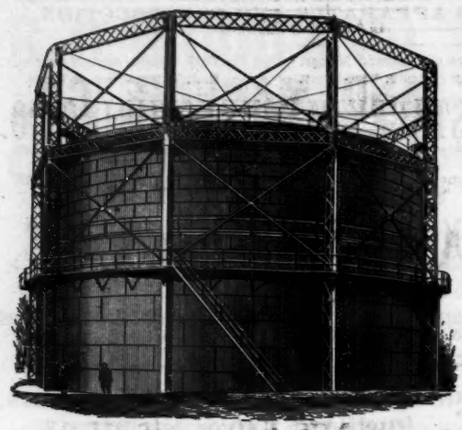

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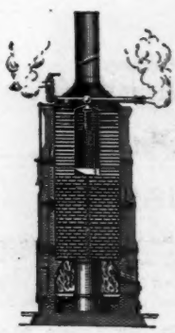

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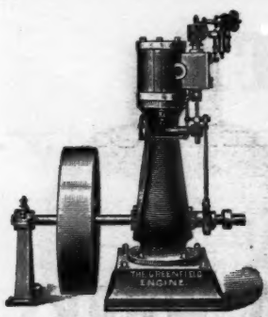

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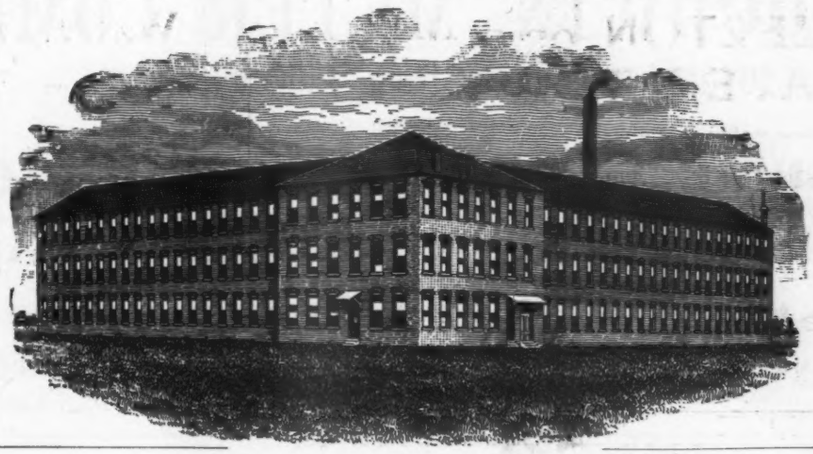

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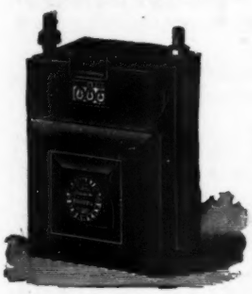

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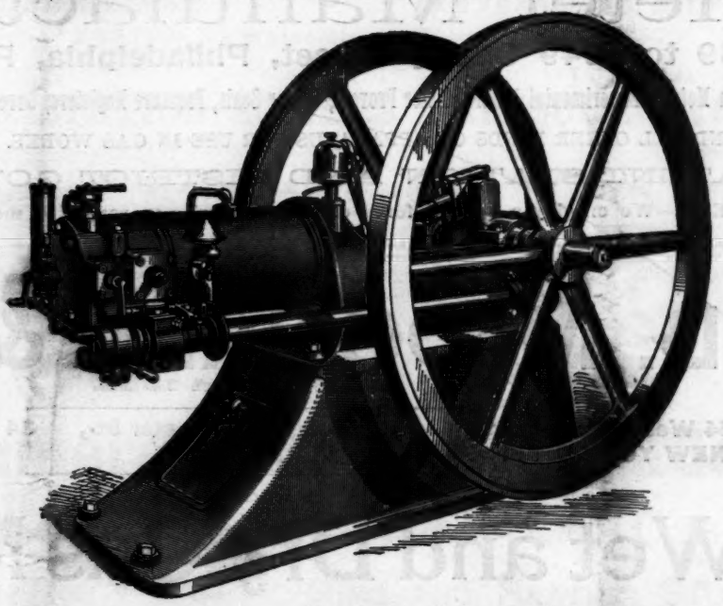

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